

Introducing the BC-348

Back in October 2001 (Wow! Was it really that long ago?) we launched the first of what became a very popular group of articles on the World War II aircraft “command set” receivers. Paired with the transmitters that were also part of the system (designated SCR274-N by the Army and ARC-5 by the Navy), the command sets were intended for plane-to-plane communication within formations and were installed in both our fighter planes and our bombers. Beautiful in their ugliness, these amazingly compact little sets were available by the thousands in the surplus market after the war and became the basis for many a beginning ham station.

But besides interplane communications, our long-range aircraft, such as bombers, also needed facilities for communicating back to base. And for this, more sophisticated equipment was required. The receiver that evolved for this application was the BC-348, a set that was designed to be operated by a specialized radio-man rather than a fighter pilot. Like the command sets, the BC-348 was also available in large numbers after the war and was eagerly snapped up at bargain prices by the amateur radio community.



At the controls of a BC-348 in a B-17 radio cubicle. Floyd Jury, shown here some 65 years ago, has been a radio enthusiast since grade school and is an active member of The Antique Wireless Association. Courtesy AWA.

Unlike the single-band 6-tube command receivers, the much larger 8-tube BC-348 was a multiband set and had more advanced features such as a crystal filter, a v.c. control and adjustable bfo. Like the command equipment, the ‘348 was powered by a built-in dynamotor that operated from the plane’s 24 v.d.c. electrical system.

While the spare simplicity of the command sets gives them a lot of physical charm, the BC-348s are (at least to my eyes) just plain ungainly. But what these radios lack in appearance, they make up for in historical significance. These are the radios that were installed in the B-17s and B-29s, piloted by our intrepid young air crews,

as they droned over Europe laying waste to Axis manufacturing plants and bases.

❖ Some BC-348 History

Different models of the BC-348 are designated by different letter suffixes. One list I have seen shows at least 20 of them. Some letters indicate only minor electrical or physical differences; others may refer only to the set’s manufacturer or a specific contract.

Here’s what I’ve been able to piece together. The historical background comes from Bill Fizette’s “The Communication Receiver” column in the August 1986 issue of *The Old Timer’s Bulletin* (Now *The AWA Journal*, for which I have the pleasure of serving as Editor). In the article, Bill quoted at length from an interview he conducted with H.A. Robinson, the BC-348’s original design engineer. (By the way, Bill still writes “The “Communication Receiver” for our publication.)



BC348 front view—see text. Courtesy AWA.

At any rate, the BC-348 started life in the early 1930s as the BC-224, which operated from a 12-14 volt aircraft electrical system. The first major production run (the BC-224-A – manufactured by RCA) was in 1936-1937. In 1938, specifications were released for a substantially improved BC-224, and this, too, was manufactured by RCA (as the BC-224-B).

With the changeover to 24-28 volt electrical systems in military aircraft, the BC-224-B had to be redesigned. I imagine that the voltage change was necessitated by the increased power demand aboard the aircraft. This was the same reason automobile electrical systems changed over from six to 12 volts in the late 1950s. It meant that power could be transferred at lower currents, and therefore over smaller gauge wires.

The change gave rise to the BC-348-B, which was identical to the BC-224-B except for the different dynamotor and the different tube heater wiring necessitated by the higher-voltage

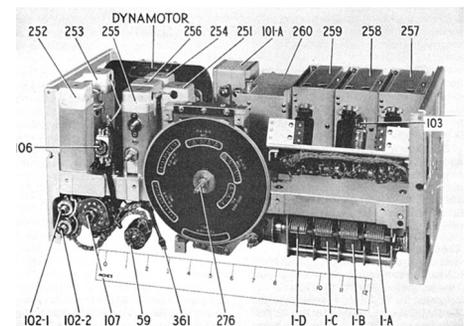
power supply. The BC-224-C and -D and the BC-348-C (apparently there was no -D) seem to be identical with the -B models of each set – the only difference being in production run contract.

However, an important change took place with the -E models of both radios. Long-range military aircraft were beginning to make extended flights over water, and there was a need for a low frequency band for communication with ships. Accordingly, beginning with the BC-224-E and BC-348-E, the 1.5 - 18 MHz frequency range formerly covered in six bands was compressed into five – freeing a switch position for a new 200-500 kHz band.

❖ Alphabet Soup

At this point, the letter suffixes became associated not so much with physical changes as with different contracts with different manufacturers. Because of growing wartime needs, RCA was no longer the only manufacturer of these radios. Stromberg Carlson, Belmont Radio and Wells-Gardner all became suppliers. The military maintenance manuals for these receivers are very helpful in identifying letter suffixes that refer to identical, or virtually identical, sets.

For instance the manual for the BC-348-E and BC-224-E also covers the BC-348-M, -O, -P and -S as well as the BC-224-G, -H, and -L. And it specifically states that the sets are – for all intents and purposes – identical (except, of course, for their voltage requirements, as described earlier. Let’s call these sets group 1.



Inside the BC-348—see text. Courtesy AWA.

Another group of virtually identical sets (group 2) is the BC-348-H, -K, -L, and -R as well as the BC-224-F and -K. Group 2 seems to differ from group 1 only in that its audio output tube is an octal-base 6K6GT instead of a tall glass, 6-pin 41. According to Robinson, the

shorter "GT" style tube, which would certainly have been preferable to the tall glass ("ST" style) type in a combat radio, was simply not available at the time of the earlier design.

Group 3, including BC-348-J, -N and -Q (no BC-224 versions), does differ markedly from the first two. Though the external appearance is identical, the design is revised and simplified – using single-ended equivalents of the top-cap types found in the former groups. (In a single-ended tube, all of the connections are made at the bottom of the socket.) In addition, this group uses a combined oscillator/mixer tube (6SA7 pentagrid converter) instead of the separate oscillator and mixer tubes in the earlier groups. All in all, the tube types used are more like those found in a home entertainment receiver of the era. There are also physical differences in the arrangement of the i.f. strips.

❖ Features of the BC-348 and BC-224

All sets have two stages of r.f. and three stages of i.f. with tube complements as shown in Table 1. Table 2 shows the frequency ranges for the various bandswitch positions in sets with and without the low-frequency band.

The receiver's few simple controls can be clearly seen in the front illustration (from the Bill Fizette article previously mentioned). At the upper right center is a dial light control that would be used, I presume, for dimming under combat conditions. The binding posts at lower right are for the antenna and ground. Just above them is the antenna adjust trimmer. The bandswitch is the star-shaped control just below the tuning dial. A rotating mask in the dial turns with the bandswitch, positioning a



The BC-348 provided reliable base communications for long-range bombers such as the B-17 (shown) and B-29.

window that exposes only the band in use.

Below and to the right is the tuning knob, which is equipped with a convenient spinner. One of the features of these receivers is the very fine and precise geared-down tuning. But without the spinner, it would take quite a while to get from one end of a band to the other. The knob to the left of, and slightly below, the tuning knob is the BFO (beat frequency oscillator) adjust control. It controls the tone of the signals heard during Morse operation.

Proceeding to the left of the BFO control, you'll see the volume control, the bat-handle switch selecting manual or automatic volume control (MVC or AVC) operation and a couple of phone jacks. As it stands, this radio does not have enough gain for speaker operation, nor is it equipped to match a standard low-impedance speaker. Of course, it wasn't unusual for hams who acquired these sets as surplus after the war to add an extra audio stage and proper audio transformer to drive a speaker at their stations.

Above the MVC-AVC switch is the switch for turning the BFO on and off, and to the right of that is a switch for cutting the crystal filter in and out. You may be wondering about the wide, screwed-on plate below the pilot light dimmer. It's there to provide access to the otherwise-inaccessible underside of the r.f. deck for troubleshooting and servicing.

I've included a shot of the set minus its cabinet (also from the Bill Fizette article) to give you an idea of the interior construction. To my eyes, at least, this radio is a lot prettier on the inside than on the outside. Now you can see how the masks for the tuning dial are staggered, so that they reveal only one specific band

when in the upright position. The black dynamotor is visible at the left rear, and the i.f. transformers (which can be individually unplugged for servicing) are on the deck in front of it.

The r.f. deck is located at the top right of the chassis, with the four-gang tuning capacitor below it. The coil enclosures are directly behind the deck. Notice the square can (labeled 101A) at the center rear of the chassis. This is the audio output transformer. By moving a tap on it, one can change the output to match either 4000- or 300-ohm headphones.

This concludes our introductory tour of the BC-348. Next time we'll take a good look at the unit that's in the shop awaiting restoration and see what problems we might be facing. It should be interesting!

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TABLE 1

TUBE COMPLEMENTS—BC-224 AND BC-348

	BC-224-A	Group 1	Group 2	Group 3
1RF	6D6	6K7	6K7	6SK7
2RF	6D6	6K7	6K7	6SK7
OSC	76	6C5	6C5	—
MIXER	6D6	6J7	6J7	—
OSC/MIX	—	—	—	6SA7
1IF	6D6	6K7	6K7	6SK7
2IF	—	—	—	6SK7
2IF/CW OSC	6F7	6F7	6F7	—
3IF/DET/AVC	6B7	6B8	6B8	—
3 IF	—	—	—	6SJ7
DET/AVC/CW OSC	—	—	—	6SR7
OUTPUT	41	41	6K6GT	6K6GT
VOLTAGE REG	—	991	991	—

TABLE 2

FREQUENCY RANGES (IN MHz) BY BANDSWITCH POSITION

	1	2	3	4	5	6
EARLY SETS	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.5	10.5-14	14.0-18.0
"E" SUFFIX AND LATER	0.2-0.5	1.5-3.5	3.5-6.0	6.0-9.5	9.5-13.5	13.5-18.0

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More on the Trans-Oceanic and BC-348

I thought I had finished with the Trans-Oceanic project in the April issue. But, as this is being written, the April issue has just hit the stands and stimulated several reader comments. They were reactions to my having put my foot in my mouth while describing the i.f. alignment process. The e-mails that came back to me over this point were so interesting that I may just decide to plant controversial comments in future restoration discussions!

Here's what happened: the T-O service literature for my Model B600 suggested sliding a sheet of metal under the chassis (which was out of the cabinet at this stage) during the alignment. The idea was to simulate the presence of a battery pack that would normally be in the cabinet below the chassis. My rash remark was that I was going to forget the metal because the Trans-Oceanic would likely never again be operated from a battery pack.

❖ Battery Packs for Tube Longevity

The remark probably still applies to my radio, but what I hadn't taken into consideration were the many T-O enthusiasts who not only like to work on the sets, but enjoy listening to them frequently. These hard-core folks worry about the effect of our higher present-day line voltages on the fragile tube filaments, as well as the high inrush current that flows when power is applied to the filaments while they are cold. For example, here's a quote from an e-mail received from Jay Policow:

I had one comment about your Trans Oceanic Restoration. You said that these radios will not likely be powered by batteries ever again. You should know that there is a huge market for battery packs for these units...the best of which is linked below:

cgi.ebay.com/Zenith-Trans-Oceanic-Transoceanic-Antique-Radio-Battery_W0QQitemZ120102898306QQcategoryZ9330QssPageNameZWDVWQrdZ1QQcmdZViewItem.

(Note: "The manufacturer seems to sell the packs by individual e-Bay auctions, but—says Jay—can also be reached by e-mail for possible negotiated sales. The supply operates from 9 D-cells and is fully regulated—m.e.)

I have used one of these battery packs for several years as have several of my collector friends and can attest to its excellence. It generates absolutely no noise and allows portable operation—the way these radios were meant to be used! The battery pack also allows you to

isolate the radio from powerline borne noise.

Of course, there are lesser battery packs out there, too. Some utilize an array of AA or 9-volt cells, but the D cell model is by far the most deluxe—offering soft start, stabilized voltages, even an output connector to plug directly into the original lamp plug. This pack is 100% plug and play and delivers about a 100 hour life on a set of D alkaline cells. Even though my A600L is completely restored, I seldom need to operate it on AC anymore. This battery pack is an awesome addition for a Trans Oceanic owner.

I don't know if you belong to any Yahoo chat groups, but there is one for the Trans oceanic which is truly superb: <http://groups.yahoo.com/group/thetransoceanicfanatic/?yguid=87007587>

Here are selected comments from another interesting note—this one from Chuck Cassidy, AC7GZ.

I am an avid reader of the "Radio Restorations" column (actually I read the entire magazine about 4 times cover to cover). I did want to make one comment regarding the statement "there would be little chance of this set ever operating again with any kind of a battery pack..."

I cringe when I read such comments because the utilities have (mostly deliberately) set transformer taps on distribution systems so that the "nominal" 110V which was common in the 1950s has crept up to 120V and higher. Here in Chandler, Arizona, where I live, I routinely see 123V as read on a Fluke 23 VOM which has been recently checked. As of this writing, it is at 119.6.

As original purchasers of the Zeniths noted, tube life while operating from the AC line was noticeably shorter than when operating with batteries. It became clear that the filament voltages ran significantly higher than the maximum 1.4 VDC tube ratings. Imagine what 1.56V will do to those tiny filaments!

A very cheap and easily assembled 90-volt "B" battery pack can be constructed using Walgreen's "Heavy Duty" 9V cells, which regularly sell for about 99 cents each. Ten batteries snap together in series fashion very easily and can be joined with electrical tape. To make the 9-volt "A" battery, series-connect three Radio Shack 2-D cell holders. One thing you might note is that even standard (not to mention alkaline) 9V and D cells of modern manufacture are far superior to the 1950's

vintage A/B battery packs. The tiny filament and plate currents barely stress them. I have a T-O which has been operating (infrequently) for about 8 years on one such pack.

For AC line operation I recommend a neatly packaged inrush current limiter made by Zim Electronics. (There's a 150-watt unit for \$34.95 and a 300-watt unit for \$39.95—S&H extra. An AC voltmeter on the panel confirms operation. Order directly from ZIM Electronics, 205 Brigham Hill Rd., Milton, VT 05468 or visit the *Electric Radio Magazine* web site at www.ermag.com for more info or to order on line—m.e.).

❖ Other T-O Comments

Craig, N3TPM, sent some info on a transistorized dynamotor substitute for the BC-348—which I'll unveil after we get a little deeper into our '348 restoration. But also included in Craig's note was a reference to an article on the construction of a hollow-state replacement for the rare T-O 1L6 converter tube. It can be found on the web site of the Michigan Antique Radio Club. Get to it by Googling "Robert Pierfelice" (the author's name), or go to www.antiqueradios.com/marc/116.html

I also heard from Mark Schoonover, KA6WKE, reacting to a comment I had made early in the Trans-Oceanic restoration. I was hoping that the multi-section electrolytic would turn out to be good (which luckily turned out to be true), because it was going to be tough to find room for four individual replacements under the chassis. Mark reported that he solved a similar problem in a friend's radio by removing the capacitor's guts and installing individual replacements within the can.

Finally, as long as we've reopened the T-O restoration issue, here's a PS from your column author. It applies to testing tubes in the Trans-Oceanic and to most other "three way" portable radios that operate from either a.c./d.c. power or a battery pack. Do not have the radio plugged in and turned on when removing and replacing the tubes!

In these sets, the filaments operate from the radio's "B" supply when the set is running on "plug in" power. Since they are series-connected, all the filaments go out when one tube is removed—removing all the load from the power supply. Without a load, the power supply filter capacitor will charge up to about 150 volts. Plug the tube you've just finished testing back into the set and the 150 volts will appear across the filament string instead of the

usual low voltage (8.4 volts in the case of our T-O)—instantly burning out at least one filament.

Some radios (not including the T-O) have a bleeder resistor that prevents such accidental charge-ups. But don't count on it!

❖ A First Look at Our BC-348

Returning to the BC-348 project we introduced in the May issue, it's time to unveil the actual specimen that will be the subject of our restoration. It happens to be a BC-348-R, which means (see the chart for "Group 2" in the May issue) that it has "double ended" (top grid cap) r.f. and detector tubes, a 6K6 audio output tube, and a 200-500 kHz LF band.

★ ★ BC-348 RECEIVER



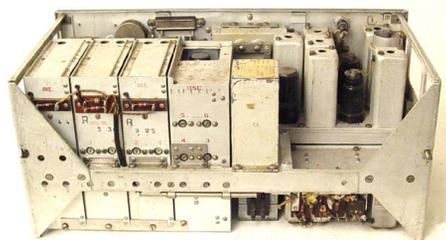
After World War II, hams and SWLs snapped up BC-348s at bargain prices (from a 1947 Radio Shack ad).

Like most of the surplus gear that was in popular use right after World War II, this one was, at one time, "converted" (that is, modified to run on 115 volts). Its 28-volt dynamotor had been removed, and the 115-volt power supply that once replaced it is now missing. The only signs of that are the stubs of the owner-installed connecting wires that were cut when it was removed.



The front panel view of our BC-348-R reveals a lot of cosmetic problems. Non-matching knob at lower left (to be replaced, of course) is from an aircraft audio control box of the same vintage.

The friend from whom I acquired this set told me that he had to search around for quite awhile to find me a cabinet. And, since I knew that the radio had been shed-stored for some time without one, I wondered about what I would find when I looked within. It turned out that the cabinet was identified as being for a



Inside, the set looks dingy, but has no sign of corrosion or mouse occupancy.

BC-348-N, but I was happy to have it!

As expected, the insides of the radio were kind of dirty but—since they were mostly aluminum—I found no rust or corrosion. It looked like most of the dirt would clean off with a little soap and elbow grease. And, being cabinetless, the receiver had—at least—never become a secluded private home for generations of mice.

Cosmetically, this set is going to be a bit of a problem. The paint is dirty and chipped in places. Someone had run a red marking pen around the perimeter of the bottom half of the dial bezel. For reasons equally unknown, the background of the identification tag had been painted over, though all markings had been crudely masked so they would not be obliterated.

The removable front-panel plate that gives access to the r.f. deck wiring for servicing was originally missing, but my friend had really helped me out here by fabricating a very nice replacement. I would have to do something about its finish, though, because the fresh semi-gloss paint wasn't quite at home with the worn flat black crackle on the rest of the radio.



"CAATC" asset tag suggests that this radio might have made several Atlantic crossings aboard a Pan American Airways flying boat (see text).

An unusual asset tag on the upper-right-hand corner of the panel suggested that this set may have had a very interesting past. It is marked "CAATC No. 1092" and indicates that the set was issued to Pan American Airways and that its weight is 39.2 pounds.

We know that the Civil Aeronautics Administration was formed by President Roosevelt in 1940 and given responsibility for, among other things, air traffic control. At the onset of World War II, the CAA widened its ATC operations tremendously, utilizing radio communication. Eventually they were communicating not only from control tower to plane, but also with planes en route to their destinations.

At the start of World War II, Pan American Airways was our only carrier experienced in flying international routes. Its facilities, equipment and expertise were immediately pressed into government service. Pan Am navigators trained their Army Air Corps counterparts. Using the company's fleet of big Boeing B-314 flying boats (or "Clippers"), the luxurious interiors gutted for carrying cargo, Pan Am made countless Atlantic crossings during the war. In 1942 alone, for example, the Clippers made over 1200 Atlantic crossings, carrying over three million pounds of war material.

So, it might not be too outrageous to imagine that the "CAATC" designation on my tag might stand for "CAA Traffic Control" and that this BC-348 radio might well have been assigned to Pan Am for installation in one of the fabled Boeing flying boats. More on the project next month. In the meantime, let me know your thoughts about this interesting CAA asset tag!

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BC-348 Restoration Begins

Last month, we took a first look at our BC-348 project set. At that time, we didn't do much more than remove the receiver from its cabinet and look at the cosmetic issues. The wiring looked relatively undisturbed – which certainly was a plus. On the minus side were various cosmetic problems.

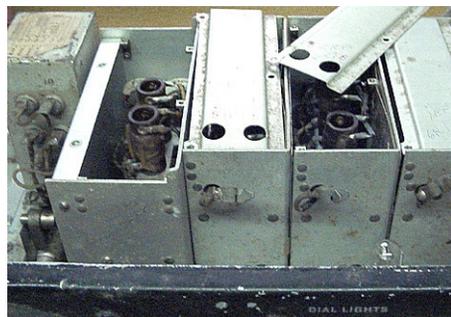
Since the set had been shed-stored without a cabinet for some time, the interior looked rather grimy. However, since most of the metal parts were aluminum, there was no sign of pitting or corrosion. It looked as if going over the surfaces (at least the ones that could be reached) with a damp cloth would result in a significant improvement.

The front panel also had its cosmetic problems. Not only was it quite grimy, but there were numerous small dings where paint was missing as well as a couple of more mysterious issues. For one thing, someone had run a red marking pen over the panel under the bottom of the dial bezel; for another, it looked as if some amateur masking and repainting had been done on the ID plate.

After assessing the situation, I thought I'd begin with some dismantling. For starters, I removed the top and bottom covers from the c.w. oscillator, first and second r.f., and converter modules.

These modules can actually be removed individually from the chassis. It's done by releasing and withdrawing the bandswitch actuating shaft that runs through all the modules, disconnecting a few wires at each module, and removing the mounting screws.

Looking inside each module, I noted that none of the wiring had been disturbed. The only reason for dismantling the modules would be to apply cleaning spray to the bandswitch contacts, which were otherwise inaccessible. So I decided to put off making a decision about removal until the radio was operational and I could see if bandswitch noise was going to be a serious problem.



Disassembly began by removing covers from c.w. oscillator, first and second r.f., and converter modules.

❖ Front Panel Restoration

I definitely *did* want to remove the front panel, however, because of all the cosmetic problems I would have to deal with. It looked, at first, as if this would be a daunting task because of all the controls mounted on the panel. But after reading the maintenance manual on this subject I was reassured.

Once the knobs (Allen wrench required) and mounting nuts were removed, most of the control shafts could be slipped back through the panel, leaving the controls and their wiring attached to the radio. Incidentally, on removing the knobs, I found that most had little leaf springs contacting their inner surfaces. Looks like the intent was to prevent the knobs changing position during combat or simply from the normal vibration of the plane in flight.

I began work on the panel by scrubbing it with a solution of Murphy's oil soap. I used a rag cut from an old bath towel, figuring that the rough texture would help penetrate the pores of the dingy



All knobs were taken off as first step in removing front panel.

black crackle finish. My solution turned black from all the dirt that was removed, though the paint finish was still dull and blotchy looking.

Next I turned my attention to the red outline that somebody with nothing better to do had drawn under the tuning dial bezel (I had removed the latter from the panel to gain better access to the area). Through experimentation, I had found that the red ink or crayon was reasonably soluble in rubbing alcohol – which was not attacking the underlying paint to any great extent.

Using a Q-tip saturated with alcohol, I rubbed along the red line, turning the Q-tip frequently and changing it often. I stopped after more black paint than red material was being picked up. The red outline on the panel was much fainter now and I didn't want to chance exposing

Improve Your Library by Sharing!

Not long ago, our Editor sent me a book that was reviewed in the December 2006 issue of *MT*. Having finished with it, she wanted me to pass it along to a reader of this column. The book is *Crystal Clear* by Richard J. Thompson, Jr. published in 2007 by the IEEE (Institute of Electrical and Electronic Engineers). It deals with the difficulties of getting the idea of channelized communications accepted by the armed services during World War II and, that accomplished, of arranging for the manufacture of the vast number of crystals that would be required.

If this specialized book would be of interest to you, e-mail me a note telling me why and attach a photo of yourself, perhaps in your workshop or study, for the column. If I've already sent out the book by the time I hear from you, you will receive a Lindsay Publications book instead (see following).

Several years ago, while I was writing an antique radio column for the now-vanished *Popular Electronics* magazine, I received two big boxes of books from Lindsay Publications. Those of you who don't happen to be familiar with Lindsay might like to visit www.lindsaybooks.com for a peek at the fascinating array of wild and wonderful titles offered by this unique publisher of technical reprints.

The books Lindsay sent all dealt with antique radio or wireless topics. The idea was to get them into the hands of readers of my column to enhance their interest in our fascinating hobby and, at the same time, make them aware of the quality and scope of the Lindsay offerings. As it happens, I wasn't able to use the books in the way I had originally planned, and they've been sitting in a corner of my office ever since.

I'm still not sure of the best arrangement for distributing the books to our readers, but let's try this for now: e-mail me a short biography, to be shared with other readers, describing your history in the antique radio hobby and some of your recent activities and/or restoration projects. Attach a good picture of yourself – perhaps in your workshop with a completed or in-process restoration project. Don't forget to include your address; all submissions will be rewarded with one of the Lindsay Publications books.

bare aluminum under the black finish.

Turning my attention to the many small dings where paint had flaked off, I found that a black felt-tipped "Sharpie" pen could be used to cover the exposed aluminum. This much improved the look of the panel, but I still have to deal with the dullness and unevenness of the finish.

Incidentally, while washing the panel, I noticed that the temporary film of moisture markedly improved the looks of the beat-up ID plate, giving it a much more unified appearance.

Recapping the BC-348

Last month, we removed the front panel, tubes, and various access plates from our BC-348-R and did some preliminary cosmetic work on the panel. By circuit-tracing some remaining wire stubs, we also “reverse engineered” the strategy used by the previous owner of the set in installing the now-missing a.c. supply. This month’s session will be focused on recapping the radio.

❖ Paper Caps in Mica Clothing

In the BC-348, as in some other military radios, the paper capacitors used for bypass, coupling, etc. are housed in rectangular plastic shells that make them look as if they are micas. Restorers who make this assumption and decide that they are low-risk usually regret it.

In fact, these units are as notorious for failing as the infamous Sprague “Black Beauty” (otherwise known as “Bumblebee”) capacitors encountered in our previous (Trans-Oceanic) restoration. Any conscientious restoration of a radio harboring the “quasi micas” must include the replacement of every one of them.

When I got my first good look at the innards of the BC-348 with capacitor replacement in mind, I was taken aback. Most of the troublesome paper caps were tightly wired to “resistor boards,” as they are called in the manual, that are diabolically mounted so that access to the capacitors is blocked by various structural elements.

At first I thought that I might gain access by removing the resistor board mounting screws (quite a job in itself – involving snaking a screwdriver through packed wiring and also getting a grip on the sometimes-almost-inaccessible mounting nuts). After disconnecting some of the wiring at

the top of these boards, I thought I *might* then be able to tilt the boards over so I could reach the capacitors. However, I soon realized that two of the boards were mounted in such a way that either one would interfere with the tilting of the other.

❖ Repopulating the Resistor Boards

I couldn’t imagine a military repair technician – perhaps under the incredible pressure of working in a battle zone – being able, in a timely manner, to find and swap-out a buried capacitor that had gone sour. Not even with the amazingly detailed repair manual provided. And at first, I didn’t see how I myself could manage the recapping without dragging this project on for so long that you, my readers, would get bored out of your skulls. Then I saw a way of accomplishing the task that would not only save time, but actually make the job go faster than it would in a conventionally-wired set.



Here are two of the resistor boards after they were populated with new capacitors.

I’m including a close-up of a section of the largest resistor board so you can see my strategy. At the top of the picture, you can see the tops of three of the inaccessible capacitors – all are definitely untrustworthy paper caps.

Notice that each has a lead that is bent over the top of the board and soldered to a terminal lug on the other side. Though not visible in the picture, a lead from the bottom of the capacitor is similarly bent around the bottom of the board and soldered to another terminal lug. It’s not apparent because of the angle of the photo, but the two lugs are far enough apart to accommodate the small size of a modern replacement capacitor.

To replace each capacitor, then, I could clip its top wire, disconnecting it from the terminal lug. This would effectively remove the capaci-

tor from the circuit even though its bottom wire would still be connected to the other lug. The new capacitor could then be wired across the two terminal lugs – both of which are readily accessible.

There are ten paper capacitors, all .01 mfd, mounted on three resistor boards in the main chassis (i.f. and audio stages) of the set. As each of these was disconnected, I checked it for leakage and rated capacity. I was amazed to find that, without exception, the leakage of each was so high that it sent the meter on my capacitor tester off scale in the wrong direction.

Furthermore, not one of the capacitors opened the “eye” of the capacitance bridge either at .01 mfd or at any value on any scale!

Without exception, these components were acting more like high-value resistors than capacitors. As I was going through all the boards, I smiled when I found that one of the original capacitors had already been swapped out using the method described – except that the previous owner had managed to remove the old cap through a convenient opening nearby. It sure couldn’t have helped much!

❖ The Other .01s

Besides the ten .01 mfd capacitors on the main terminal boards, there was one associated with a tube socket on the main chassis and six more on the small shelf holding the tubes for the r.f. and converter stages of the receiver. The one on the tube socket was no problem to change, but the ones on the tube shelf were a little harder. For one thing, each fit so tightly between its mounting/solder lugs that it was impossible to get in to cut its leads.

And the capacitors were stacked so tightly against each another (three one side of the chassis and three on the other) that they were almost impossible to move. Somehow I managed to wiggle each of these capacitors back and forth enough so that its leads broke off. Again, I felt very sorry for the technician in the wartime repair depot who might have needed to replace just one of these caps – say at the bottom of a stack.



The r.f. and converter tube shelf with six new capacitors (three on each side) installed on the old terminal lugs.



Inaccessible capacitors (top part of picture) were removed from the circuit by cutting their leads where they wrapped around the top of the resistor board. This made it possible to install new caps on the other side of the board (see text).



The c.w. oscillator module removed from its can. Original paper capacitor still in place. The flexible cable at the top connects with the front panel bfo control.

I'm including a picture showing the tube shelf with the new capacitors installed. Sharp-eyed readers will note that these caps look different from the ones seen installed on the main resistor boards. The reason: I had just about exhausted my supply of axial lead .01s on the resistor boards and had to switch to a back-up supply of radial lead .01s for the tube shelf.

This accounted for 17 of the .01 mfd caps in the set, but the parts list called for an 18th – which was, unfortunately, hidden inside the can holding the c.w. oscillator circuitry. That can was nestled among a couple of i.f. cans and one holding the crystal filter. I was able to pop the cover off the c.w.o. can without disturbing the other ones, and then I was able to lay eyes on the last of those .01 mfd nasties.

However, being able to see this problem cap and being able to remove and replace it were two different things. There just wasn't enough clearance for me to get my hands in there. I was going to have to remove the entire assembly from the radio.

This was, frankly, an unpleasant little task because of the dense, tight wiring to – and surrounding – the four leads to be removed under the chassis. I had to cut part of the binding of a cable harness to get access, and I also had to cut two of the four leads. I would later have to lengthen each of those to make it long enough to be reconnected.

❖ Other Paper Capacitors

I'll report on the repair and reinstallation



The bank of 0.5 mfd paper bathtub capacitors. After doing some testing, I'm hoping that all might still be ok.



Just a few of those paper-caps-that-look-like micas originally used in the BC-348. If you ever work on a set using these, you know what to do!

of the CW Oscillator can next month. But just now I was curious to see how many other paper capacitors remained in the set for me to deal with. The parts list showed no less than seven two-section .5 mfd caps – fourteen in all! These turned out to be a group of bathtub capacitors (caps sealed in metal cans) located at the back of the main chassis next to the power/interface plug.

I checked a couple of these for leakage and capacity. I think they are close enough to the leakage standard of 2k megohms to be worth a try and they're "on the button" as far as capacity value. I believe I'm going to leave the whole lot in place and troubleshoot them later only if they seem to be causing problems.

❖ Hi-Rez Manual Source

By the way, here's another word of advice to those of you looking to download a BC-348 manual. Last month, I advised you to go to the BAMA mirror site at <http://bama.edebris.com/manuals/> There you will find a collection of military manuals unparalleled in scope.

However, to make sure uploading and downloading times are of reasonable length, these manuals were not scanned at the highest resolution. Many of the photographs, especially of dark objects, are almost unreadable black blurs.

But, just the other day I discovered the James A. Moorer BC-348 page (www.jamminpower.com/main/bc348.jsp). There you will find a selection of manuals superbly reproduced at high resolution. I located a manual for the BC-348-H, which I know from my research to be identical to my BC-348-R (see the May 2007 column). It took my DSL connection over an hour to download its 162 MB (I broke for dinner while it was going on). But the results were well worth it.

The photos in my printout show all the sharpness and detail one could ask for. A complete, well-illustrated manual is really a great help when working on an unfamiliar radio!

❖ Tubes Pass the Test

The last project I took on in this work session was just to test the eight tubes. All of them checked out perfectly – not a weak one in the bunch. That's at least somewhat of a sign that the previous owner had powered up the set correctly and used it intelligently.

Working on a war surplus set that has no doubt passed through the hands of one or more ham or SWL experimenters with unknown

degrees of competence is always a bit dicey. Careful as one's own work might be, the results might still turn out to be unsatisfactory if the previous owner has made a wrong connection or left something out. Then it becomes necessary to try and troubleshoot the maze of semi-inaccessible parts and tightly cabled wiring. But, I guess that's really part of the fun of radio restoration!

Next month, we'll finish up the repair and reinstallation of the c.w. oscillator can, complete the cosmetic work on the front panel, and reinstall the panel on the radio. We'll also decide what sort of power supply to use and perhaps get that together so that we can try the set out.

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To access the restricted website for the month of August, go to www.monitoringtimes.com, click on the key, and when prompted, enter "mtreader" under the user name. Your password for August is "storm" – Check in each month for new material!



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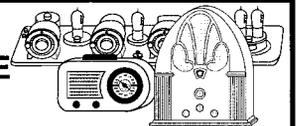


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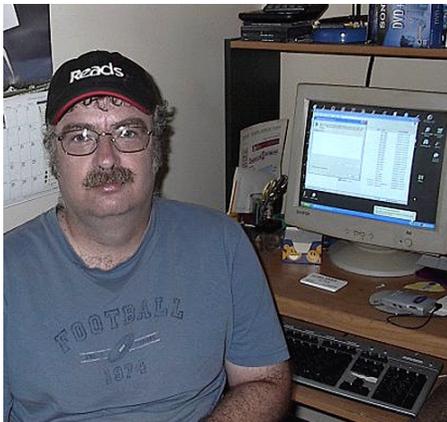
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The BC-348 Restoration Continues

❖ From the Readers

Our first request for one of the Lindsay books (see box in August issue) comes from Reid Eisenhauer of Moncton, New Brunswick, Canada.

Health problems keep him at home, so he fills his time with his stamp collection and radio hobbies. One of Reid's first projects was a Radio Shack AM radio kit. This was followed up with a CB radio receiver kit that really got him hooked on radio. The first time he used it, he was able to pick up skip from a long way off.



Reid Eisenhauer's hobbies include computers, SWLing and, now, tube radios.

Later, computers became his main interest, but he continued SWLing and also built some crystal radios from the Lindsay book, *Radios That Work For Free*. Lately Reid has developed an interest in tube radios, and is beginning to read up on them – which led him to become a reader of this column. A ham friend is encouraging him to study for his amateur license, and he hopes to get on the air soon, preferably using tube gear.

I have more Lindsay books to give away, so don't be shy. Send me a pic, a couple of paragraphs about you and your hobby activities, and your address – and see what you get from the grab bag!

Bobby, K4VE, writes that he recently bought two BC-348s from a person who is downsizing his collection, so is now avidly following this restoration series. Joe Erickson, N8PMF, also recently purchased two BC-348s and is following our series with interest. One is an -R and one a -Q, so he has examples of each of the basic versions of this set.

Both of his radios were missing nameplates, so Joe had some replacements made at a trophy shop. Right now, he is busy backing out owner mods – and has found a wealth of information on the internet. If you haven't done it yet, just Google BC-348 and see what turns up.

❖ Checking Resistors

Last month, we changed out all of the paper capacitors in our BC-348 – including the one hiding in the c.w. oscillator can. It wasn't possible to take care of that one without removing the can from the radio – a job that turned out to be a bit of a bear. This month's work session began with putting the can back together and reinstalling the radio.

I hope I don't have to take it out again! I recently read of a BC-348 restorer whose c.w.o. refused to work until he had replaced a mica capacitor in the can. I hadn't thought of doing that while I had the can open since mica caps so rarely go bad.

With the paper caps taken care of, I turned my attention to the resistors. One BC-348 restorer wrote that he had become suspicious of his resistors when he came across one that

seemed to have spontaneously snapped in half. After doing some checking, he found that most of the others were seriously out of spec. (With age, some carbon resistors will significantly increase in value.)

I thought I had better look into the condition of the resistors in my set – keeping my fingers crossed. After replacing all the caps, I certainly wasn't looking forward to wholesale resistor replacement. Of course it isn't possible to measure the true value of a resistor without removing it from the associated circuitry; in circuit, it can be shunted by other components. But I used a practical technique recommended by a friend.

One checks each resistor without removing it from the circuit. If the resistance reads way too high, it definitely needs to be replaced. If the resistance is significantly lower than specs, this resistor is probably being bypassed by other components. Ignore it for now, but keep it in mind for later checking if the radio doesn't behave after being powered up. Actually, all of my resistors read very close to their marked values – so I began to have some confidence in their condition.

❖ Front Panel Installation

I had removed the front panel of this radio back in July and done a little cosmetic work on it. After washing with Murphy's Oil Soap, I used Q-tips and rubbing alcohol to get rid of most of the red crayon someone had used to outline under the bottom of the tuning dial bezel. After that the panel looked better, but the crackle finish was still dull and lifeless. I did make a major improvement in the looks of the ID plate by coating it with gloss varnish before temporarily setting the panel aside.

Now it was time to complete the job so that I could reinstall the panel on the set. Writing in the January 2007 issue of *The AWA Journal* (Quarterly Bulletin of The Antique Wireless Association), Lane Upton recommends the use of WD-40 lubricant for restoring a crackle finish or other painted surface.

The lubricant is simply sprayed onto a cloth (Turkish toweling material recommended) and applied thickly to the surface. After sitting for five minutes, the excess is removed with paper towels. Then more Turkish toweling is used to polish the remainder into the finish. After this treatment, Lane recommends that the piece be allowed to sit for 24 hours, after which it can be handled without leaving fingerprints.



Peeking between a couple of shield cans at the opened c.w. oscillator gives us a view of the replaced paper capacitor.



Thanks to its front-panel face lift, our BC-348 is beginning to look quite sharp – even without its control knobs.

I used this quick-and-dirty technique on my panel with very satisfactory results. The overall color has deepened and the white finish on the raised lettering now stands out much more vividly. But I can't say that the crisp texture of the original crackle finish (still visible in the protected area under the dial bezel) was restored. And there is a little more sheen in some areas than others. However, this set had been stored under less-than-ideal conditions for some time and I suspect that the weathering on the finish is irreversible.

The re-installation of the front panel took a lot longer than the original disassembly! A few of the retaining nuts were located in spots where fingers could not go. The same was true of the tapped metal plates that serve as nuts for the two handles. The handles could have been installed with ease had I been smart enough to put them on before assembling the panel to the chassis. That'll teach me to make better notes next time I dismantle a set!

❖ Power Supply Considerations

With the panel back in place, I turned my attention once more to electrical issues. There is still finish restoration work to be done on the knobs, but I decided to wait until the next work session to complete that and reinstall them.

What I wanted to do now was to decide on where to put the a.c. power supply for the radio. Some restorers choose to build the supply into the well formerly occupied by the dynamotor. Others prefer to locate the supply outside the set, connecting it to the innards via an umbilical cord. I would have preferred the inside location, but the size of the parts available in my junk box dictated otherwise.

As mentioned earlier, a previous owner had rewired the heater circuits of this radio to operate from 6 volts rather than the original 24. All of the tubes are actually 6-volt types, but had been wired in a series/parallel arrangement to arrive at a 24-volt input. I decided to leave the wiring change in place so that I could use a standard receiver power transformer in my supply.

To match the output of the original dynamotor, the B plus supply would have to deliver about 225 volts at – I would guess – about 100 ma. As it happens, the receiver transformers I had that would fit comfortably in the dynamotor well fell short of a 100 ma. rating. The ones that would provide at least 100 ma. were too big.

I don't know how many of you have priced out new transformers at one of the antique radio supply houses. Those who have done so will understand why I decided to go with something that I already had on hand. Ergo – my power supply would have to be external.

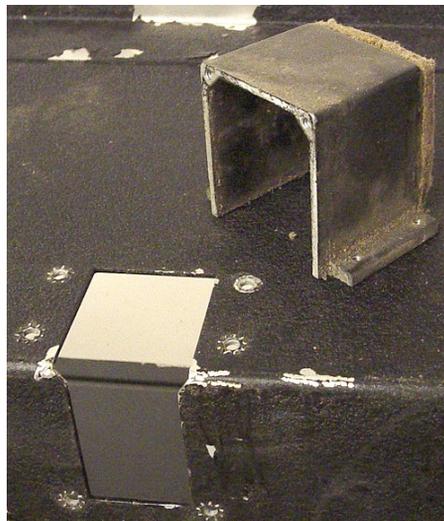
Having decided that, I would have to figure out how to get the wires from the power supply into the cabinet without drilling a hole. There were no ventilation holes or other existing cabinet penetrations I could use. The receiver's connections to the outside world are normally made through a male plug that does exit the back of the cabinet, though there are no openings around it that might provide a route for my wires.

I didn't want to remove the plug or modify its wiring in any way. However, I noticed that the aluminum casting surrounding and sealing off the plug could be removed from the cabinet by taking out six screws. Doing that created an opening under the plug through which I could pass the wires. I plan to tape the casting and a packet containing the screws to the floor of the empty dynamotor well – along with a note explaining where the piece came from.

❖ Setting Up the Connections

Without worrying too much about the design of the power supply I would eventually put together, I decided that I would now install the connecting wires. These would be individual wires that would be about 18" long after passing out of the cabinet. Of course they'd be sized appropriately to carry the expected currents. Eventually they would be bundled into a cable and fitted with a plug for connection to the supply.

As previously mentioned, an earlier owner had removed the original screw-terminal power connection strip along with the dynamotor and brought the leads to unused lugs in a terminal strip at the back of the chassis. The stubs of the connections that had once gone to his power supply were still soldered to these lugs. I have to admit, it gave me some satisfaction to remove these poorly soldered stubs and replace



Removal of the connecting plug shield from the inside of the BC-348's cabinet makes it possible to feed in power supply wiring without drilling holes.

them, one by one, with neatly installed leads of my own. In each case, I double-checked the schematics to make sure that the connection was being made to the correct point.

And speaking of checking connections against the schematic, I want to stress, again, the importance of acquiring a complete maintenance manual before beginning restoration of a BC-348. If at all possible, get one of James A. Moorer's superb scans from his site at www.jamminpower.com/main/bc348.jsp. It is well worth the long download time.

The pictorial diagrams are of particular importance in working on a set where the wiring is almost all enclosed in tight cables. These are the diagrams where the parts and connecting wires are shown as representational drawings rather than schematic symbols. For instance, tube sockets, terminal strips and plugs are shown much as they look in real life. Each interconnecting wire is drawn in position in its cable and may be traced with the help of a straight edge. The draftsmen who produced these incredibly detailed drawings were totally amazing.

Of course, in some situations, you will also have to rely on the standard symbolic schematic drawings – which emphasize the electrical interrelationships between the components rather than how they are connected physically.

I'll be back with you next month, when we'll clean and reinstall the knobs, add a power supply, and conduct a smoke test.

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The BC-348 Gets a Smoke Test

One of the things we accomplished last month was to install the connections that would be needed to bring power into the BC-348. This month, we'll make use of them to apply the power and give the radio a "smoke test." But first, all of the control knobs, which had been removed earlier in the restoration, needed to be cleaned, touched up, and reinstalled.

The knobs were placed in a small plastic container and swirled around in a dilute solution of laundry detergent. After a few minutes of this, the solution took on a very satisfying dark gray hue. Though quite a bit of grime had obviously been removed by this tactic, I found an old tooth brush and worked on all the nooks and crannies with more of the solution.

After rinsing with warm water and drying with a paper towel, the knobs were ready for a little touch-up to cover spots where paint had chipped, revealing bare aluminum. For this I resorted to the BIC "Mark-It" permanent marker pen that had been very effective on the front panel. Marker fixes are obviously much more convenient than dealing with paint, and the marker ink – being basically dye – doesn't have an obvious heavy texture.

Replacing the knobs was a simple enough procedure, but one that occasionally required some strategy. Several of the knobs were in positions such that there was limited clearance to swing the Allen wrench needed to tighten the setscrews.

For these knobs, I was careful to tighten the screws as much as possible *before* installation – leaving them just loose enough so that the knobs would slip over their shafts. That way, there would need to be only a minimum of further tightening once a knob was in place. I also seated the wrench properly before slipping a knob on its shaft so at least the first swing

could be done without having to search for the setscrew from an awkward position.

❖ The Smoke Test

We were now fast approaching the event that the past several columns had been leading up to: powering up the radio for the first time in who-knows-how-many years to see what would happen. For this purpose I had my eye on a neat little power supply salvaged from a '60s-era console several years ago. It was unusual in being a separate unit – mounted in the speaker area of the set – rather than an integral part of the radio chassis.

It would be perfect, I thought, as an external supply for the BC-348. It was even equipped with a convenient socket and plug with extra contacts set up for a remote on-off switch. Powering up the unit slowly on a Variac, I found that the high-voltage circuit was in good order, delivering a robust 300 volts. But it turned out that the filaments of the original radio had run on 12.6 volts rather than the 6.3 volts I had expected.

I would have to put this little supply away for some future use, but as a matter of convenience I decided to leave it on the variac to supply temporary high voltage for testing the BC-348. I found a separate transformer to provide the needed 6.3 volts for the filaments.

I connected the filament circuit first – through an a.c. ammeter to make sure that the current draw was close to the expected two and a half amperes. Since the filaments – originally in series/parallel for 24-volt operation – had been rewired by a previous owner for individual 6.3-volt feed, this would be a good indicator of whether all tubes were lighting properly. It would be hard to determine this visually, since most of the tubes are metal.

The ammeter reading checked out and, after several minutes, all



Temporary lashup for test-powering the BC-348. Meters and variac (see text) not shown.

tubes were warm to the touch. It was time to plug in my World War II era headphones and apply the high voltage. I connected the power supply, along with meters to monitor voltage and current (the latter to warn me of any abnormal drain caused by a short circuit), and slowly advanced the Variac until I reached the 250 volts required by the receiver.

The current remained within reasonable limits, reaching up to about 100 mA at certain control settings. And I'm happy to say that *no* smoke was observed. I wish I could now tell my readers that the receiver had immediately come to life at this point. Nine times out of ten, with careful preparatory housekeeping and recapping, that is exactly what would happen. But not this time!

I wasn't surprised. This is a complicated radio to work on and troubleshoot. And I had not only my own possible mistakes to worry about, but those perhaps yet undiscovered that might have been perpetrated by previous owners. What I did hear was...nothing...except for a muted a.c. hum. Then I realized that I had the mvc-off-avc switch in the "off" position.

Switching over to "avc," I did hear what sounded like atmospheric static crashes – which was encouraging. However, the receiver was unresponsive to screwdriver-scratching of the antenna post or any of the r.f. or i.f. grid caps – nor was the noise affected in any way by moving the bandswitch. Results in the "mvc" position were similar.

❖ Cleaning the Volume Control



With knobs installed, front panel is now virtually complete. Hole at upper left, made by previous owner for a fuse, may eventually accommodate a fuse holder or a send/receive switch.



Hole drilled in rear potentiometer of the volume control made it possible to inject a shot of control cleaner.

The old girl was essentially dead except for the static crashes, which were apparently being internally generated somewhere. The volume control didn't have much effect on that noise – but generated ear-splitting static of its own every time it was moved. To save my ears, I decided that the next move would be to clean the volume control contacts.

The volume control is a dual potentiometer. The rear unit functions only in the “avc” position and controls the audio level to the output tube. The front unit functions only in the “mvc” position and is an r.f. gain control, operating on the r.f. amplifier tubes and the first and second i.f. amplifier tubes.

To accomplish the cleaning, I'd have to remove this dual pot, first disconnecting the six wires and making careful note of which terminals they belonged on. Once that was done, I could see that there were no openings into which I could squirt control cleaner fluid. I'd have to do some disassembly.

The front resistance element was easily released from its shell by bending up the retaining tabs. And I could see that the wiper arm had a little protrusion that engaged a notch in an assembly at the bottom of the shell. This, obviously, is how the wiper arm of the rear potentiometer was rotated along with that of the front one. I made careful note not to move either arm while the units were separated in case it might be difficult, later, to find the “sweet spot” where they locked together.

The tabs on the rear element were not easily accessible – being covered by the shell of the front element, which was still in place on the rear assembly. My only option was to do something I had read about but never tried, namely to drill an access hole in the rear cover that would be big enough to accommodate the nozzle of the “straw” on my pressure can of control cleaner.

Previous disastrous experience in similar situations had taught me that there would be no way I would be able control the travel of the drill bit after it had broken through the thin metal. So this time I played it smart and first used the bit to drill a hole through a piece of scrap 2 X 4. Then I adjusted the position of the bit in the drill chuck so that the tip just cleared the bottom of the block.

Doggone those keyless chucks! In use, the bit kept pushing itself back into the chuck just enough to prevent the tip from going all the way through the metal. But the last thing I wanted to do was to destroy this control, so I was very patient – advancing the tip just a tiny bit each time until I was rewarded with a very nice round hole in the back of the rear cover – and *only* in the back of the cover.

Liberal squirting the exposed front element with control cleaner, I carefully inserted it back into the shell and refastened the tabs. Then, using the newly made opening in the back element, I inserted the nozzle of the control cleaner can and administered a healthy dose.

After working the control back and forth, several times, through its complete travel, I was ready to reinstall it. It was now much quieter, though there are still a few rough spots that I hope will take care of themselves with time. Before I close up this radio for good, I'll stick a square of plastic electrical tape over the hole.

❖ Next Steps

Having come this far, I really wanted to begin the troubleshooting process. But there were a couple of obstacles.

When troubleshooting, one must be able to reposition the set frequently in order to access various tube sockets and other diagnostic locations. But right now, the set is hooked up to a couple of different power sources using a number of temporary (and uninsulated) connections. Each move would require the rechecking and redoing of these connections – a tedious process that would also open the way for error.

And so, before doing any troubleshooting, I've decided to put together a permanent power supply for the radio. As mentioned, I had originally intended to use, externally, that neat little salvaged supply. But since it has turned out to be unsuitable, I'll shoot for building a permanent supply into the dynamotor well.

I also would like to avoid any further testing with earphones. The loud clicks and static crashes can be quite uncomfortable, if not painful! But the BC-348's audio output impedance (you can choose 300 or 4000 ohms) is not suitable for the usual 6-8 ohm speaker.

Some BC-348 “restorers” have decided that the set doesn't even have enough gain to operate a speaker. They have modified the radio by adding another stage of audio and replacing the original output transformer with a conventional one having a 6-8 ohm output.

However, knowledgeable folks assure me that there is more than enough gain. All that is needed to install a speaker is a salvaged conventional output transformer. Take it from almost any junker radio with a single-ended output stage – even an old a.c.-d.c. job.

First, make sure that the BC-348's output transformer is set for 4000 ohms. Then plug the primary of the output transformer into the BC-348's headphone jack and connect the secondary to the speaker. Actually, you may very well be able to salvage a speaker with the transformer already mounted on it and wired to it. The result: a speaker system with more than adequate volume and attached to the receiver without making any modifications.

To locate the trouble in this radio, I plan to start with the *signal substitution* method. Basically, one begins at the audio output stage – injecting an audio signal from a test generator. If that signal makes it to the speaker, one moves backwards, stage by stage, injecting appropriate signals (audio, modulated intermediate frequency or modulated radio frequency) into each one. The stage which does not pass the signal through to the speaker is the one that is in trouble.

The most direct way of troubleshooting the defective stage, once found, is to begin by comparing the voltages at its tube terminals with the normal ones listed by the manufacturer. Large discrepancies will point the way to failed components. In some cases, including this one, the manufacturer will also have provided normal resistance readings from each terminal to ground. These will provide additional diagnostic information.

See you next month for the trouble-shooting session!

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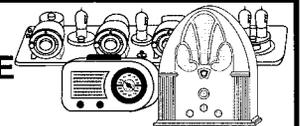
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Power Supplies for the BC-348

Last month, we powered up our BC-348 World War II aircraft receiver for the first time. I had intended to use a handy little salvaged power supply from my junk box as an external power source. However, I was disappointed in that the heater winding of its transformer turned out to be 12 volts. (My BC-348 heaters had been rewired from their original 24-volt configuration to run on 6 volts.)

I went ahead and used the supply for initial testing, adding a Variac to cut down its too-high plate voltage and a separate transformer to light the 6-volt heaters. Though I was happy to see that no smoke issued forth, the radio was essentially unresponsive. It did make some noises that sounded like atmospheric disturbance, but operating the band change switch, changing the tuning, or scratching the antenna terminal with a screwdriver had absolutely no effect.

I was anxious to begin troubleshooting, but my temporary power hookup, with its many clip-lead connections, was an inhibiting factor. When troubleshooting, one must be able to move the radio into a variety of different positions to access various test locations. That's hard to do when there are half a dozen or so clip leads to disconnect and reconnect each time!

Finding Parts for Internal Power

Since my idea for the external supply didn't work out, I decided to do what many restorers had done before me: build a power supply into the empty dynamotor well. (My radio, like most of its relatives, had lost its dynamotor back when World War II surplus equipment was just coming on the market and the hams and SWLs were converting it to plug-in power.)

The original dynamotor chassis was about 4" X 6". It had been mounted over a well about 1/2" deep using 8-32 screws at the corners. The chassis for an a.c. supply could be cut to the same dimensions and fastened over the well using the same tapped holes that had accepted the dynamotor screws. There'd be room for a power transformer and choke on the top surface and adequate clearance for tie strips, small components and wiring underneath.

My first problem was to locate a suitable power transformer and choke. I had many examples of both in my junk box but, as luck would have it, all were either too big or too small. The transformer's 6-volt filament winding would have to supply about 2 1/2 amps and the high-voltage winding – specified as 600

volts (center tapped) by some sources – had to deliver over 100 mA. Of course, the choke also had to be rated at over 100 mA. The units I had on hand that were big enough electrically proved to be physically too big for the available space.

However, the Antique Wireless Association Annual Conference in Rochester, NY, was coming up, and a friend of mine with a *really* well stocked junkbox would also be attending. I put in a call and he promised to look – using his own BC-348 as a size reference. Not only did he come through with a nice-sized transformer, but I was also able to find an appropriate choke in the conference flea market.

Preparing the "Chassis"

To get the size and hole placement for the power supply chassis, I made a template from a piece of cardboard liberated from the back of a notepad. Drawing a rectangle on it just a little bigger than the required size, I cut it out with a



The empty dynamotor well on the BC-348 chassis.

scissors. Then I cut it down, bit by bit, on both dimensions until it was a good fit.

To get the placement for my mounting screw locations, I centered the template over the dynamotor well and duct-taped it down. Then I applied rubbing pressure with my fingertips over each of the tapped holes until its outline began to show through the cardboard. Adjusting a desk lamp for crosslight, I could now see good representations of the openings. Carefully estimating the center of each opening, I used a nail to make holes through the cardboard at those locations.



Fitting a cardboard template over the dynamotor well.

I found some sturdy 1/8" composition board to make the power supply chassis and, using the template as a guide, cut it to the correct size on my table saw. Then the template was taped to the board and I marked each one of my mounting screw locations by making a puncture with a nail hammered through each of the previously-made holes in the template. Drilling holes for the screws was an easy matter, and I made them slightly oversized to compensate for any small errors in placement.

After making sure that the board was a good fit and all the mounting holes lined up with the tapped holes at the dynamotor well, I began to lay out the power supply parts. It was an advantage to have this "chassis" made of composition board rather than metal. The material was easy to drill and far more rigid than sheet metal might be. And there was no need for a ground in the power supply circuit because, in the BC-348, the B minus is "floating."

The Power Supply Circuit

The power supply circuit employs a standard full-wave rectifier. I'm including a schematic of the BC-348 power supply that was recommended in a popular surplus conversion handbook of the mid 1940s (Figure 1). This is essentially the circuit of my supply, except – to save space and power – I used a couple of

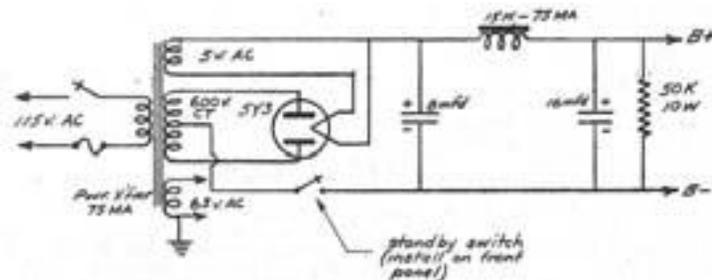
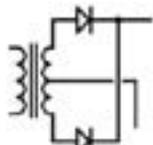


Figure 1. Suggested BC-348 power supply from 1940s conversion publication (see text).

Figure 2. Diode replacements for tube in Fig. 1. Top lead goes to plus side of filter; bottom lead to minus.



silicon rectifiers (Figure 2) instead of the 5Y3 rectifier tube.

Also, though my choke was unmarked, I'm pretty sure it isn't as large as the 15H size specified on the schematic. In view of that suspicion – and since high-value electrolytic filter capacitors are common and inexpensive – I substituted 33 uF units for the 8 and 16 uF sizes specified.

By the way, I don't think that the 75 mA size specified for the choke and transformer in Figure 1 would be quite adequate. My set, at least in its current condition, is drawing about 120 mA. There's also no need to drill a hole in the front panel to install a standby switch that lifts the transformer center tap. Standby circuitry is built into the BC-348 and can be accessed through a couple of tab connectors on the rear plug. We'll get into that later.

With the power transformer and choke mounted on top of the chassis, the capacitors, bleeder resistor, and necessary terminal strips fit comfortably underneath. However, I did have to exercise some care to make sure that none of the parts were close enough to the edge to brush against the sides of the dynamotor well.

Firing up the completed power supply for testing, I found the plate voltage being delivered under load was over 50 volts too high. This wasn't unexpected, because the output of the transformer's plate-voltage winding was a little high, the internal resistance of the silicon rectifiers is a lot lower than that of a rectifier tube, and there are those oversized filter capacitors.

I don't know if you have ever priced new power transformers suitable for tube gear. But if you have, you know why we usually do our best to adapt the best used transformer we can get for our purposes. The trick often used to reduce plate voltage is to insert an appropriately-sized power resistor in series with the transformer's center tap.

I found, after some cut-and-try experimentation, that I was going to need about a 600-ohm 10-watt resistor for this purpose. The closest I could come out of my junkbox was a unit made up of four 2500-ohm 2-watt resistors wired in parallel. This composite resistor was of the correct ohmic value and could handle the power dissipation.

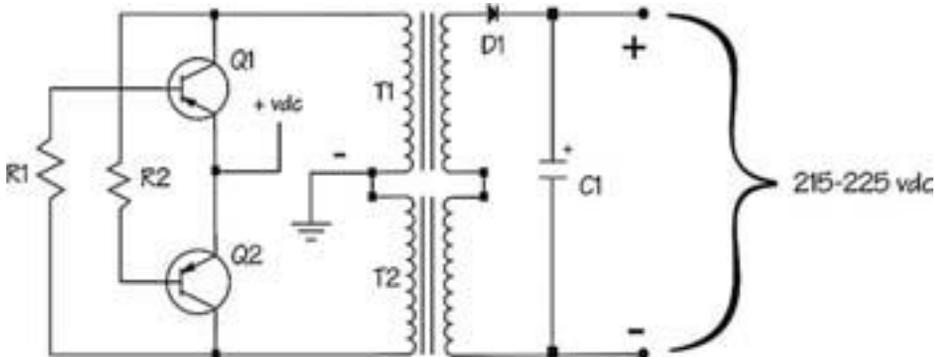
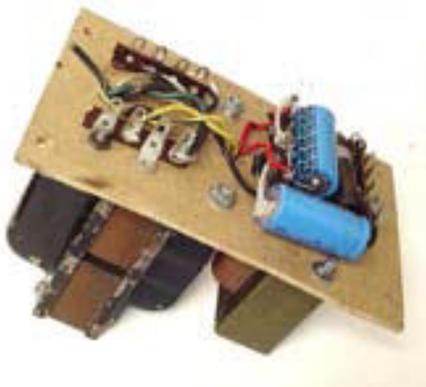


Figure 3. N3TPM's circuit for solid state dynamotor replacement. See text.



The power supply board is now almost ready to mount over the dynamotor well.

With the insertion of these resistors, my new power supply was operating the radio as well (or as poorly!) as my lash-up of last month. However, there was no way I could find room for the four resistors on my power supply board! So I wasn't yet able to install the power supply in the radio and had to resort to using it externally with clip leads connecting to the temporary resistors.

I've included a 600-ohm 10-watt resistor in my latest parts order. Once it arrives, I'll be able to find a spot for it on the power supply board – preferably on top of the board for good heat dissipation. Then I'll be able to proceed with the troubleshooting that I've had to put off for the last couple of months!

For the Purists: A Solid State Dynamotor

Perhaps you have a BC-348 that is mint and untouched, except for the dynamotor having been removed. You'd prefer to run it on d.c. and not make any of the wiring changes necessary to install an a.c. supply. Craig, N3TPM, has an answer for you. Using his circuit (Figure 3), you can build up a solid state dynamotor replacement for installation in the dynamotor well in much the same manner as the a.c. power supply just described.

Transformers T1 and T2 are low-voltage transformers with 120-volt primaries. They are hooked up in reverse so that the high voltage appears at the output. Use transformers with 12-volt, 2 amp secondaries for 12-volt operation; with 24-volt, 2 amp secondaries for 24-volt operation.

PNP power transistors are 2N6109 or equivalent. These must be heatsinked. Check the data sheet for your transistors to see if the heatsink tab is connected to internal circuitry. If so, and if your "dynamotor" is to be built on a metal panel or chassis, you'll need to add mica insulators under them.

Diode D1 is a 500-volt (or better), 2 Ampere unit (1N4007 or equivalent). Capacitor C1 is a 40-80 uF, 300-volt electrolytic. Resistors R1 and R2 are 10,000-ohm, 1-watt.

Remember, just as with the a.c. supply described above, the negative output is not to be grounded, but connected directly into the receiver circuitry as specified on the schematic.

We'll see you next month when, at last, we should be able to get into some serious troubleshooting!

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A Permanent Power Supply for the BC-348

Back in June, when I first began to talk about our BC-348, I speculated on the meaning of an interesting asset tag attached to the upper-right-hand corner of the panel. It was marked “CAATC No. 1092,” and indicated that it was issued to Pan American Airways.

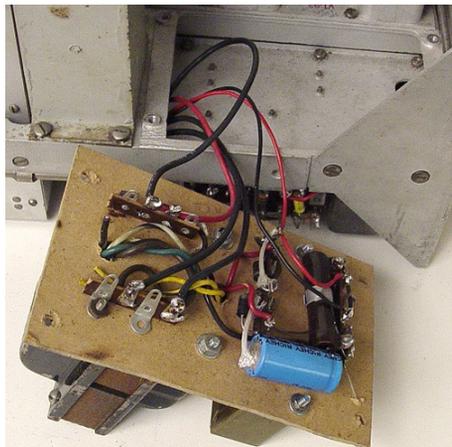
I had guessed that the “TC” in the designation perhaps stood for “traffic control,” one of the Civilian Aeronautics Authority’s major functions. And I speculated that the radio might have been placed in one of PAA’s fleet of Boeing B-314 flying boats (or “Clippers”) that had been pressed into service to carry war materiel across the Atlantic during World War II.

Well, maybe this BC-348 was indeed used in a Pan American Clipper, but that is about the only part of my guess that hasn’t been disproved. In response to my request for reader input on this matter, I recently received a note from Whitham D. Reeve of Reeve Engineers in Anchorage, Alaska. He writes:

The CAATC designation on your BC-348 stands for CIVIL AERONAUTICS AUTHORITY TYPE CERTIFICATE. This was a government certification that indicated radio equipment was suitable for use on airplanes used in the civil air traffic control system. A lot of military radio equipment was certified under CAATC after the war, usually by very minor modifications to improve reliability or accuracy.

❖ Completing the BC-348 Power Supply

Last month, I made up a composition board “chassis” to use for an a.c. supply that would fit over the dynamotor well of our BC-348. The supply was put together using a power transformer



Power supply connected to the newly installed wiring for testing.

contributed by a friend and a choke I picked up at last August’s Antique Wireless Association Annual Conference. With this transformer, the B plus voltage turned out to be about 50 volts too high.



A replacement fuse block was installed at the original fuse location, but raised on a spacer for easier access.

After putting in a dropping resistor of some 625 ohms, temporarily made up of four 2500-ohm power resistors in parallel, the B plus dropped to a level near enough to proper so that I could test the supply with the radio. And I found that the radio was working as well (or as badly, as I put it last month) as it had with the temporary supply I haywired together for the test I had made the previous month.

It would have been messy to use the four 2500-ohm resistors even if I had room for them – which I didn’t. So I ordered a few 10-watt power resistors with various values around 625 ohms, and these were on hand at the start of this month’s work session. I tested a few of the new resistors by clip-leading them in series with the power transformer’s center tap (essentially putting them in series with the power supply’s negative bus).

It turned out that a 680-ohm resistor gave a power supply output close to the 220-volt B plus that the BC-348 expected to see. However, I was concerned about the loud hum I had heard in the headphones during both this month’s and last month’s tests.

This could simply have been a symptom of whatever is wrong with the receiver. (Remember, the set isn’t working yet!) But I wondered if the problem might have something to do with the

location of my dropping resistor and the fact that, in the BC-348, the power supply’s negative lead is not connected to receiver ground.

Acting on this hunch, I reconnected the high-voltage center tap directly to the negative bus and placed my dropping resistor in series with the B plus lead to the radio. I was gratified to find that the hum had now dropped considerably, and was at a level that was quite acceptable. However, for some reason, the B plus at the set had increased to about 260 volts. This was of some concern because a group of metal-cased paper capacitors that I have not replaced in the set carry 250-volt ratings.

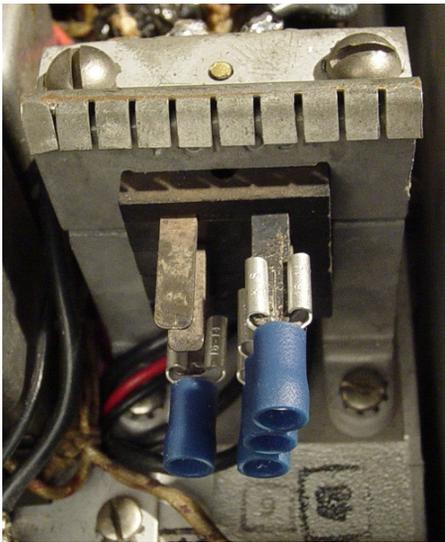
Since I didn’t have a higher-value dropping resistor on hand, I decided to try reconfiguring the power supply filter from capacitor input to choke input. This was accomplished simply by removing the filter capacitor from the transformer side of the choke – leaving just the capacitor on the far side. The B plus voltage now dropped to an acceptable level, and I was interested to see that the receiver hum level had not noticeably increased. I now mounted my dropping resistor on top of the power supply board, where it would have more ventilation for heat dissipation, and wired it in permanently.



The power supply chassis fits snugly over the dynamotor well—which is deep enough to allow clearance for parts and wiring. I admit, the transformer and choke are not exactly pretty—but they do their job!

❖ Getting Power In

The supply was ready for connection to the radio, but there were some housekeeping issues that needed to be dealt with first. Up to this point, I had been powering the supply via a temporary line cord wired directly to the transformer primary. Now I needed to find a way to get the a.c. line into the radio through the cabinet and arrange



The power/control connector is here shown upside down to show the fit of the slide-on terminals. See the accompanying diagram, which is shown right side up, for numbering of locations.

for both a front panel switch to turn the set on and off and a fuse for the transformer primary circuit.

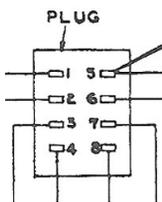
Back when I was considering powering the BC-348 with an external supply, I came upon a way of running the necessary six leads from the supply into the radio without drilling any holes. It involved removing the shield around the cabinet opening for the power and control connector. This uncovered an opening through which the wires could be snaked into the set. In case some future owner might want to reverse this modification, I had intended to store the shield and its mounting screws in the empty dynamotor well.

But now, with an internal supply, only the a.c. supply leads had to pass through the cabinet. Not only that, but the dynamotor well would no longer be empty and available to store the shield and its screws.

At this point, I made a useful discovery involving the power/control connector at the back of the set. This connector is often ignored by restorers because plugs for it are virtually impossible to obtain. However, the flat male "tongues" on the connector were just a little narrower than those used to accept standard female slide-on terminals as used in appliance and automobile wiring.

As shown in the accompanying picture, these terminals install very well on the connector tongues even though the latter are not quite wide enough to completely fill the space between the contact springs. So I could use them for their original purpose of getting power into the set.

The terminals I used are Buchanan #70072 crimp-on female disconnects sized for #15-#14 AWG conductors. I had to tin, and then double over, the ends of the smaller gauge wire in my a.c. zipcord so that they would occupy enough space to be properly crimped into the connector barrels. Perhaps similar connectors are available for smaller sized wires.



I've photographed the power/control connector upside down to give you a better view of the terminal attachments, but am also including a right-side-up drawing of the connector for your reference. The pair of side-by-side terminals in the picture (2 and 6 on the drawing) are for receiver muting. They will be shorted by a jumper in our project, but can be connected to a pair of relay or switch contacts to silence the receiver during transmission. Terminals 1 and 5 on the drawing (below 2 and 6, and not visible in the picture) provide receiver output for the aircraft interphone system. They are not used in our project.

The two terminals stacked at the top of the picture (3 and 4 on the drawing) will be used to bring the a.c. line into the set. They are on tongues that were originally wired together at the back of the connector and used to input plus 24 volts to the receiver. A lead went from the tongues to a fuse block under the chassis, and then from the block to a switch segment on the "avc-off-mvc" control. The 24-volt power was applied to the tube heaters and the motor circuit of the dynamotor whenever the switch was placed in the "avc" or "mvc" position.

A previous owner of this radio had rewired the tube heaters to operate from 6 volts and separated their circuitry from the "avc-off-mvc" control. The dynamotor had also been disconnected and removed so that the switch segment that had been used to control 24-volt power was now isolated from all other circuitry and could be used to control the 115-volt input to an a.c. power supply. For some reason, this owner had also removed the fuse block from under the chassis and transferred the wiring to a new fuse holder, for which he had drilled a hole at the upper left of the panel.

❖ New Power Wiring

I thought it would be a really poor idea to run 115-volt a.c. through 60-year-old switch contacts and wiring that had been designed for 24-volt d.c. There was the possibility of insulation breakdown, not to mention hum that might be induced by wires never intended to carry alternating current and tightly cabled with sensitive tube input wiring.

Then, too, I wanted to avoid an odd feature built into the "avc-off-mvc" control. Perhaps the World War II airborne radio operator didn't have need to switch between mvc and avc often. But whenever he did make such a switch, he would have to move the control through the "off" position, which would cut power to the radio. The resulting thermal jarring couldn't have been good for the heater filaments or the stability of the receiver, and the frequent stopping and starting could certainly have shortened the life of the dynamotor.

I decided to bypass the original power control switch segments entirely, substituting a separate, independent, toggle switch mounted in the hole that had been made for the panel mounted fuse holder. Not only was the hole convenient for the purpose, but its upper left position on the panel seems to make intuitive good sense for an "on-off" switch.

Thanks to the remarkable detail built into the superb pictorial diagram of the radio provided in the manual, I was easily able to determine the

location of the original fuse block. And I happened to have on hand a similar one, though it was designed for one-hole mounting rather than two. I used one of the two threaded holes provided for the original holder to mount the replacement.

Disconnecting the wiring from the back of terminals 3 and 4, I connected a lead to one of them, leaving it long enough for the free end to reach comfortably into the nearby dynamotor well. The other terminal received a lead that was connected to the fuse block – which, in turn was connected to one side of the new power switch. The other side of the switch received a new lead which was neatly routed through the set to the location of the dynamotor well.

I now had six leads to be run into the well – the B plus, B minus, and heater leads installed in a previous work session as well as the two new a.c. power control leads. These were threaded into the well through a convenient slot at one end.

Now it was the work of just a few minutes to solder the leads onto the lugs provided on the power supply chassis – making sure to leave them long enough so that the chassis could later be maneuvered onto its mounting position in the radio. Connecting the shorting jumper across terminals 2 and 6 of the power/control connector and the a.c. line cord to terminals 3 and 4, I plugged in the receiver for the first time using the new wiring and turned it on.

Everything worked as planned so, at last, I was able to place the power supply over the dynamotor well and screw it down. This means that, in the next work session, serious diagnostic work can begin.

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The BC-348 Begins to Talk

Last month, we finished installing a permanent power supply in the BC-348's vacant dynamotor well. No more clip lead lashups! With everything self-contained, we're free to move the radio from one position to another as the diagnostic testing might require. So after all these months, we're finally at the place where many restorations begin. We can undertake the interesting process of troubleshooting.

Not that I look at all of the previous work as unrewarding. It was fun to see the front panel come to life after its cosmetic treatment and very satisfying to replace the myriad of leaky paper capacitors with reliable modern ones.

It was also quite interesting to follow, and clean up, the work of the previous owner – who had done a rational, if somewhat messy, job of applying power to the radio. He had apparently connected some sort of outboard supply, but seems to have done no other conversion work. Finally, I enjoyed putting together and connecting the little dynamotor-well power supply.

❖ First: A Fuse and a Speaker

Before beginning troubleshooting in earnest, I added an extra safety feature – a 250 mA fuse in series with the B plus lead. In the event of any trouble in the high voltage circuits, this fuse would blow much faster than the one I had installed in series with the a.c. line. I created a convenient spot for it by removing a board holding a now unused r.f. choke (labeled "100" on the schematics) that had been part of the low-voltage power input filter system.

I was concerned enough to add the fuse



Speaker and output transformer in small tabletop baffle – all scrounged from junkbox. The baffle will get a coat of black paint to match the radio.

because of a group of original metal-cased paper capacitors that I had not changed out. They had tested well for leakage and capacity, but are rated at only 250 volts. The B plus voltage, however, peaks at some 300 volts – not dropping to about 220 until the tube heaters warm up and the tubes begin drawing current from the supply.

I was pretty sure that these sealed metal-cased capacitors could handle the temporary voltage peak, but a short in one of them could ruin a difficult-to-replace part elsewhere in the circuit. So I decided to take no chances. All of the other paper capacitors in the set had been replaced with 630-volt units.

When turned on for testing, the set behaved just as it had since I first applied power to it. That is, it was silent except for random static and the earsplitting disturbances produced when the "avc-off-mvc" switch was moved or when the volume control (still noisy in spite of its previous chemical treatment) was rotated through certain spots. Nothing from the front end of the radio was getting through, as evidenced by the fact that moving the band-switch or screwdriver-scratching the antenna post or the grid caps of the r.f. tubes produced no sound at all.

Up to now, I had done all testing using earphones. But I was tired of hearing the loud static close-up and decided to put together a little speaker system for the set. As it happens, the audio output transformer of the BC-348 will not match a standard 8-ohm speaker. It can be set for an impedance of 300 ohms (to match either a low-impedance headset or the aircraft's intercom line) or 4000 ohms (to match a high-impedance headset).

Some of the old-time hams who originally converted these sets for their use tore out the original output transformer and substituted one that would match the 6K6 audio output tube to an 8-ohm speaker. Some, who felt that the audio output was too weak, even added a first audio stage ahead of the 6K6. Others took the much easier route that I followed.

The 4,000-ohm output of the BC-348 will work very well into the primary of an output transformer taken from almost any small tube-type table radio of the 1950s, 1950s, or later. The secondary of such a transformer is, of course, designed to feed an 8-ohm speaker. The output transformer and speaker could be connected to the BC-348 through one of its phone jacks with no wiring changes required.

I raided my junkbox looking for a set that I could cannibalize and – being a lazy cuss

– was hoping I might find one with the output transformer already mounted on, and connected to, the speaker. I did find a set with such a speaker, but I couldn't use it because it was an older dynamic version, requiring a source of d.c. to energize its magnet.

A little later, I located a small tabletop speaker cabinet with a 6" PM (permanent magnet) speaker already mounted in it. To this, I connected the secondary of a likely looking output transformer from the junk box and wired a length of zip cord, terminated in a phone plug, to the primary. I secured the salvaged transformer to the inside of the cabinet base with a dab of "Goop" auto cement, added a staple to keep the zip cord from pulling out of the transformer, and I was in business. So far, the volume available from this arrangement seems more than adequate.

❖ Located: A Dead I.F. Stage

Now on to the troubleshooting! I began by feeding an audio tone from my signal generator into the grid of the audio output tube and was rewarded by hearing it emerge from the speaker. Backing up a couple of stages, I set the generator for a modulated signal at 915 kHz (the intermediate frequency) and applied it through a small capacitor to the grid cap of the third i.f. tube. Again I heard the tone from the speaker – but louder. So far, so good.

Backing up another stage, I injected my test signal into the grid of the second i.f. tube. The tone in the speaker was still louder, suggesting that this stage was amplifying properly. When I backed up to the first i.f. tube, I expected the signal to be still louder – reflecting the gain of this extra stage. However, the volume dropped off to a negligible amount. Apparently I had uncovered a problem.

Now I began a voltage check on each of the elements of this tube, intending to compare the values with those given in the maintenance

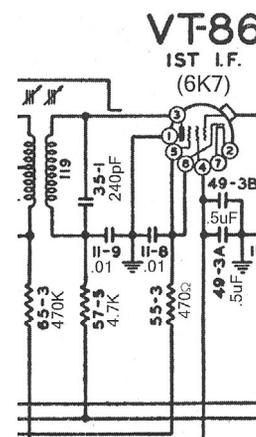


Fig. 1. Schematic of first i.f. stage showing the trouble spots (see text).

manual. But in the process, I found that there was no voltage at all on the plate.

I've shown a schematic of this stage as Figure 1. Voltage is fed to the 6K7 plate (pin 3 of the tube) from the B plus bus through 4.7 k resistor 57-5 and the primary of i.f. transformer 119. The most obvious reason for no voltage at pin 3 would be an open i.f. transformer winding.

This was a horrible thought. It's doubtful that the fault could be repaired, and one obviously can't run down to Radio Shack and purchase a BC-348 first i.f. transformer! Also, of all the i.f. transformers in the set, this would be the most difficult to change. Its base wiring and mounting nuts are buried beneath other components – notably the large “avc-off-mvc” rotary switch with its multiple cabled wiring connections.

Not only that, but the feedback loop that makes the c.w. oscillator oscillate (one end is shown as the unconnected wire above the lead to pin 3) is located right over the base of the transformer and is tied in place at a couple of locations because its positioning is critical. This is not something one would want to disturb.

❖ The Reason: An Open Resistor

The only other possibility for the fault would be if resistor 57-5 were to be open. That seemed unlikely because, while carbon resistors are known to change in value over time, they are rarely found to be completely open. However, 57-5 was open. There was voltage on the B plus side of the resistor but not on the tube side.

The resistor looked intact, but was half hidden beneath one of my replacement capacitors. Probing around under the capacitor, I felt the resistor come apart, and when I extracted the two halves, I saw that they appeared to be burned. Reflecting a moment, I thought I knew why.

Readers who have been following the column awhile may remember that, during my wholesale capacitor replacement, I found that one – and only one – had already been replaced. This was capacitor 11-9 which, if shorted (see in figure 1), would place resistor 57-5 directly across the B plus and certainly burn it out. However, as it would turn out, that replacement had been in vain.

Of course a shorted capacitor would now be unlikely since I had recapped the set and even replaced the previous replacement. Satisfied that I had



The two ends of the burned resistor after I fished them out from behind one of my replacement capacitors.

unearthed the problem, I installed a new resistor. As luck would have it, I didn't have a 4.7k resistor in the appropriate 1/2-watt size and installed a 5-watt one instead.

An ohmmeter check showed that the new resistor was not shorted to ground and, in fact, that there was continuity between the resistor and pin 3 of the 6K7. So it looked like the primary winding of the i.f. transformer was ok. I turned the set on, leaving the voltmeter connected between ground and pin 3. The voltmeter kicked up for a moment and then fell back to zero. At the same time, I felt the new resistor heating up like a small radiator.

Immediately shutting off the power, I repeated the ohmmeter check and found a low-resistance ground on the tube side of the resistor. This was the beginning of one of the oddest trouble-shooting sessions I've ever had. The only thing I could think of was that my brand-new replacement cap for 11-9 had somehow gone bad. I disconnected and checked it. It tested fine but, somehow, the short had disappeared.

Just to be safe, I installed a new cap and applied power again. But once again the short was back; the resistor was heating up and there was no voltage on pin 3. I was dealing with a very odd condition – quite possibly an intermittent short within the first i.f. transformer can.

❖ The Elusive Short Identified

Quite bummed out now, I reluctantly began to explore the possibility of removing the i.f. can for inspection. I dismantled the “avc-off-mvc” switch to see if I could move it out of the way for better access to the base of the can. But I found that I would also have to dismount the volume control and move it aside to give me access to disconnect a short lead that was holding the switch assembly back.



The base of the problem i.f. transformer (long screw protruding from center) can be seen between my large 5-watt replacement resistor and the back wafer of the “avc-off-mvc” switch.

Now I could peer down at the base of the i.f. transformer, where the three connection terminals could be seen – partly obscured by the c.w. oscillator wiring. On the off chance that perhaps a stray strand of wire could be causing the intermittent ground, I began to probe around each terminal with a fine screwdriver.

The ohmmeter was still connected, and I found I could make the short momentarily disappear by pushing against one of the terminals.

There was no sign of anything near that terminal that could cause a short, and I once again began to think that the problem must be inside the can. But then I finally spotted the trouble. It was a little blob of solder with some embedded wire that had fallen into the space between another of the terminals and the chassis. I fished it out with some forceps and the short disappeared completely and permanently!

Apparently the blob had been just close enough to the terminal and the chassis to make the intermittent ground. And even though I had been pushing against one of the other terminals, I had been moving the whole assembly enough to trigger the condition.

Reconnecting and remounting the switch and volume control, I applied power again. Now I could hear static when moving the bandswitch – a very good sign. Scratching on the antenna post with a screwdriver, I not only heard the hoped-for static, but also the distorted murmur of voices. The front end and the i.f. channel were in communication once more.

The voices were intermittent and appeared at the same place on the dial at a couple of different positions of the bandswitch. No other signals could be heard, even with a long piece of wire connected to the antenna post. So our BC-348 has still more secrets to give up before it becomes operational. More next time!

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The BC-348 Awakens - Sort Of

Yes, the BC-348 has awakened – or perhaps *almost* awakened would be a better term – from its long nap in somebody’s storage shed. And its first words were in French.

But before we get into that, I want to mention the e-mails I received from Chuck Cassidy, Michael Allen, and Kirk Ellis. Chuck describes himself as “an aging baby boomer with a genuine love for any pre-solid state gear,” and says that “Radio Restorations” is the first column he turns to on receiving a new issue of *MT*. He particularly liked N3TPM’s solid state dynamotor replacement circuit from the November issue.

Michael, who also noticed the scheme, happens to be working on a solid state design for replacing vibrator power supplies in tube-type auto radios. He’ll notify me when he posts it on the web so I can alert interested readers.

Kirk is using our BC-348 articles to assist him in restoring his own receiver.

❖ Last Month’s Progress

Now on to the awakening of the BC-348. In the previous issue of this column, with a power supply now installed, we began troubleshooting the set at last. But not before installing a fuse in the B plus line from the power supply, as well as a speaker to save my ears from the static crashes that had been coming through the earphones.

As you’ll recall, the radio had been emitting noises that – misleadingly – sounded like atmospheric static. But, actually, signals from the antenna were not getting past the front end of the receiver. Scratching the antenna post with a wire or screwdriver made no sound, nor did changing positions on the bandswitch. Working backwards from the audio output tube, we traced a signal through the various stages and found an interruption in the first i.f.

The tube had no plate voltage because – it turned out – of a freak accident caused by a previous owner. A blob of wire and solder had fallen between the i.f. transformer and the chassis, causing an intermittent short that finally burned out the plate dropping resistor. With that taken care of, the BC-348 came to life – at least to the point where scratching the antenna post or moving the bandswitch would cause lively static in the speaker.

After working for so long with a virtually mute radio, I considered that to be quite a sign of progress! Connecting a short basement antenna, I tuned around a bit. But I heard nothing

except a weak signal that I knew was spurious because it appeared at the same end of the dial on two adjoining bands. There wasn’t even much atmospheric noise to suggest that the set was alive.

❖ The Radio Awakes

At the beginning of this work session, I decided to see if I could squirt a signal from my signal generator all the way through the radio. I set the generator for a 4 MHz modulated tone and draped the output lead around the antenna post of the BC-348. And I was pleased that I could hear that signal in the speaker at close to the proper place on the dial.

Now occurred one of those great breakthrough moments that bring joy and excitement to the heart of a restorer who has labored to revive a long-mute receiver. Desiring to check for pickup on the next band (6-9.5 MHz), I clicked over the bandswitch and reached out to readjust the signal generator. But before I could do that, a man’s a sonorous voice emerged from the speaker! He was almost perfectly tuned in and giving a dramatic reading in elegantly-pronounced French.

I stopped what I was doing and listened, thunderstruck and smiling, for five minutes or more, even though I couldn’t understand a word of what was being said. Really encouraged, I decided it was time to test with an outside antenna and lugged the receiver into my radio room on the second floor of our garden shed.

❖ New Problems Emerge

After the testing was finished, I had uncovered several more interesting problems. On the plus side, I was able to pick up several signals on the 3.5-6 and 6-9.5 MHz bands and a few on the 1.5-3.5 and 9.5-13.5 MHz bands. But there was nothing to be heard on the 200-500 kHz bands. Signals overall were generally weak, and there seemed to be dead spots on whole sections of some bands. The audio was generally fuzzy – always sound-

ing a little out-of-tune – and would sometimes cut out and reappear in a manner too abrupt to be accounted for by ordinary fading.

Although, as evidenced by my earlier signal generator test, the 3.5-6 MHz band seemed to be in reasonable calibration, the 6-9.5 MHz band apparently was not. A wide cluster of 40-meter ham signals appeared well below the 40-meter lower band edge. Finally, loud static heard as the tuning capacitor was turned through certain positions, attested to the need for some cleaning.

None of these problems are exactly surprising in a radio that has been stored for a long time, without cover or cabinet, in a shed with no environmental control. And they certainly do make the job of the restorer more challenging and interesting.

My schedule this past month has given me little time to investigate these problems, but I’ve done some thinking about them and a bit of work. A check on the B plus input to the radio revealed that something had changed

since I originally set up the power supply and it was now 50 volts too low. Luckily, when I ordered the power resistor to be used for dropping the too-large power supply voltage, I had also ordered extras in a variety of sizes. Their box-like configuration made them very easy to stack, so I selected, stacked and paralleled two more units that lowered the resistance enough to bring the voltage up to the specified 220.

As a start on dealing with the apparent insensitivity of the receiver, I’ve done a quick check on the plate and screen voltages of the first r.f., second r.f. and first detector tubes. All seem to be in the proper ballpark. I also disabled an unusual sensitivity compensator circuit that I’ve seen only in the BC-348.

The arrangement consists of rheostat 78 (see Fig. 1) in series with the cathode return of second r.f. tube VT-86 (6K7 in civilian nomenclature). This rheostat is ganged to the shaft of the main tuning capacitor in such a way that it increases in resistance – decreasing the sensitivity of the receiver – as higher frequencies are tuned in.

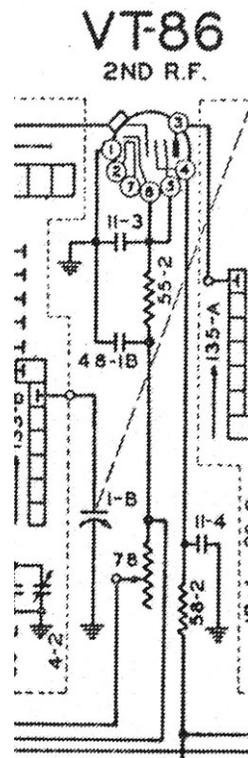


Fig. 1. Sensitivity rheostat, labeled “78,” (see text) can be seen near bottom of the picture.

According to the BC-348 manual, this was done to counteract the tendency for sensitivity to increase at higher frequencies – thus evening out the sensitivity response over the tuning range. I’ve never run into a circuit like this elsewhere – and perhaps one of you readers can enlighten me about why such a sensitivity inhibiting circuit should be necessary.

At any rate – if my experience with the volume/r.f. gain control is any indication – that rheostat is going to be dirty inside, and thus intermittent in operation. It could easily be contributing to the tuning irregularities I’ve mentioned. I disabled it simply by jumpering across the terminals to short it out. If a later owner of the set wishes to reinstate the circuit, he or she can easily do so.

❖ Plans for the Coming Month

None of these fixes have made a noticeable difference in the radio’s performance, so I have more work to do this coming month.

For instance, another obvious suspect for the dead band portions is irregular oscillator operation. Often an oscillator tube (in this case a 6C5 triode) can be temperamental and refuse to oscillate at all frequencies. I plan to order a NOS (new old stock) replacement to see if it makes a difference.

Although the manual does give the tube socket voltages expected for the 6C5, these would be difficult to check without some kind of adapter. The oscillator circuit – including the tube – is installed in a metal compartment in order for it to be completely shielded. Without the shielding, it was felt, enemy combatants with radio direction finder equipment could pick up the signal from the oscillator and triangulate on the position of the radio.

The tube itself is accessible for testing or replacement by removing a metal cover at the top of the compartment. However, without removing the whole oscillator module from the receiver – which would obviously defeat the purpose – there is no easy way to reach the underside of the socket for testing. The Air Force radio technicians had an adapter that could be plugged in between the tube and the socket to feed the socket connection points into a test set. I hope I won’t need to fabricate one!

The general insensitivity and complete lack of response on the 200-500 kHz band could perhaps be an alignment problem – especially if a previous owner had meddled with it without having the necessary know-how. This could also account for all those 40-meter ham conversations appearing below the 40-meter band edge on the dial. And so, next month, we will run through the complete alignment procedure from the i.f. chain back through to the front end.

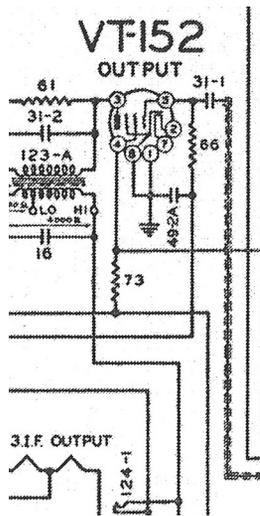


Fig. 2. Mica capacitor 31-1 (top of picture) couples diode plate 1 of second detector tube (not shown) to grid of output tube. Socket voltage measurements suggested capacitor was defective.

measured .34 volts compared to the expected value of 6. These two circuit points are connected (via the last i.f. transformer and the volume control) through coupling capacitor 31-1 (see Fig. 2). A problem with the capacitor could certainly affect both locations.

That capacitor happens to be a mica type, and I usually don’t change out micas on a wholesale basis because they so rarely go bad. However, long-time readers will remember the problem I had with the AVC of the Hallicrafters S-40 I restored some time ago. Turns out that a couple of micas had indeed gone south and were responsible for the difficulty. It took me awhile to make the fix because I felt that these capacitors were above suspicion.

Since capacitor 31-1 was easily accessible, I quickly disconnected one end so I could test it out of the circuit. Sure enough, it threw the leakage meter of my capacitor tester off scale and gave no indication of its rated .0015 ufd value on the capacitance scale. Bingo!

I’ll order a re-

We’ll also blow out the plates of the tuning capacitor, which is fortunately reasonably accessible, and use a little contact cleaner to ensure good connectivity at its bearing points.

❖ A Last-Minute Discovery

The obvious suspects for the erratic audio would be the second detector and audio output stages – although this problem could certainly originate almost anywhere in the receiver. While writing this, I became curious and went back to the bench to check the socket voltages for those two stages against the typical values shown in the manual. And I did uncover a problem.

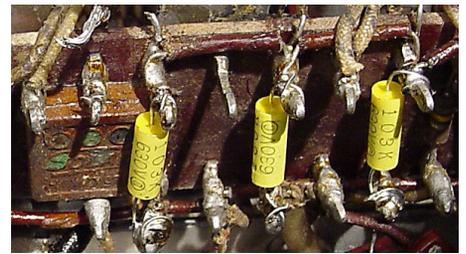
Diode plate 1 (pin 5) of the VT-93 (6B8) second detector tube read 1.27 volts compared to the expected value of 8. And the control grid (also pin 5) of the VT-152 (6V6) audio output tube



The VT-65 (6C5) oscillator tube in its shielded compartment. The compartment cover (top of picture) is a replica made by a friend.



Sensitivity control rheostat is ganged to shaft of main tuning capacitor. Note jumper shorting its terminals (see text).



Mica capacitor 31-1 (far left) disconnected for testing. It flunked leakage and capacitance tests. Light-colored cylindrical units at right are replacement paper caps installed earlier.

placement for this cap and the four or five other micas that are accessible in the receiver – most of them in the second detector and audio output circuits. As for the scores of micas within the i.f. and c.w. oscillator cans and the antenna, oscillator, r.f. and detector enclosures – I’ll just have to keep my fingers crossed! Changing those out would be a major receiver rebuild job.

I do take comfort in the fact that the bad capacitor is the largest capacity mica in the set – and its size may have had something to do with its failure. There is only one other like it, and it, too, is in the accessible group.

I’m really looking forward to the next work session – which I hope will resolve most of the problems that have been identified without turning up any new ones. Stay tuned for the next issue and find out!

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Aligning the BC-348

At the close of the last work session, I was trying to discover the reason for the very poor audio quality of our project set. Through voltage checks, I had been able to pin-point a leaky coupling capacitor. I hadn't included it in my earlier recapping because it was a mica – and micas so rarely go bad. Wondering about other micas in the radio, some of which were buried within the r.f. coil compartments, I checked the parts list.

It turned out that this particular mica was one of two identical units that were the largest (capacity wise) in the set. I thought I should at least check the sister capacitor, which the schematic informed me was connected across the primary of the output transformer. Apparently it was there to control the audio tone.

❖ The Audio Fix

When I went looking for the capacitor, I found that it was supposed to be occupying a terminal board spot right next to the one I had just replaced – but it was missing! Once again, I was following in the footsteps of the previous owner. Apparently that capacitor had also gone leaky and he decided to do without it. However, I decided to maintain the original configuration and replace the unit.



The BC-348 with instruments used for alignment. AC VTVM at left, dummy antenna atop receiver, service generator at right.

Now I was ready to turn the set on for another test. And, as I've been careful to do so far during this restoration, I immediately made a quick check of the plate voltage. Readers who have been following the story will remember

that, last month, I had to readjust the series dropping resistor in the supply to compensate for a value that, unaccountably, had become about 50 volts too low. Something I had changed had increased the current drain on the supply, which of course increased the voltage drop across the series resistor.

This time, the voltage was perhaps 80 volts too high – quite possibly the result of my having corrected the coupling capacitor problem, thereby reducing the current drawn by the output tube. So once again I had to adjust the power supply series resistor. Next time I need to find a power transformer for a radio, I'm going to work a lot harder to find one much closer to the correct voltage so I can do without a series resistor. Another disadvantage is the large initial plate voltage – in this case over 300 volts – that hits the radio before the tubes warm up and begin drawing current through the resistor.

At any rate, the receiver audio was now reasonably clean. However, sensitivity was still questionable and I wasn't able to hear a single aircraft beacon or other signal on the 200-500 kHz band.

❖ I.F. Alignment

The most obvious next move was to check the receiver's alignment, readjusting as necessary. As usual I began with the i.f. channel. Instead of the more usual 455 kHz frequency, this radio's i.f. is at 915 kHz. The lower frequency had to be avoided as it would have fallen within the 200-500 kHz band's tuning range.

A modulated 915 kHz signal from the service generator, kept at as low a level as possible, was injected, via a small capacitor, into the grid cap of the first detector tube. For a gain indicator I used an a.c. vtvm (vacuum tube volt meter). clip-leaded to the radio's intercom output terminals (located on the interface plug at the back of the receiver).

The avc was turned off to avoid the possibility of volume peaks being smoothed out.

Beginning with the fourth i.f. transformer, I worked my way back to the first one, peaking all adjustments. The top tuned circuit of each transformer is adjusted via a hollow slotted screw. The gap between the slots is bridged nicely by a

RMA DUMMY ANTENNA
20 uh choke is 49 turns No. 30 enameled wire close-wound (1/2" long) on 1/2"-diameter plastic tube.

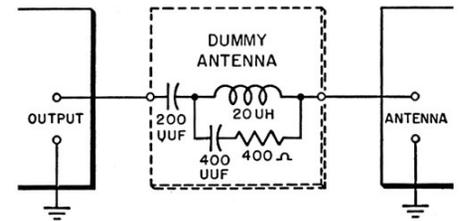


Fig. 1. Specifications for dummy antenna as originally recommended by the Radio Manufacturers' Association.

wide-bladed screwdriver. The screw turns easily and a metal blade is ok – not affecting the gain of the circuit as it is inserted or withdrawn.

The lower tuned circuit requires a screwdriver thin enough to pass through the hollow upper screw so it can engage the lower adjusting screw. This screwdriver must be non-metallic, which created a problem because none of my plastic screwdriver-tip alignment tools was long enough to reach that bottom screw.

Here's where my collection of oddball alignment tools came in handy. (I pick those things up at flea markets whenever I have a chance, and I advise you to do the same!) I did have a tool long enough, but it had a rectangular cross-section tip for who-knows-what-purpose. A few strokes of the file on each side of the flat converted it into a screwdriver tip that performed the adjustments very nicely.

It's a tribute to the quality of the components built into this radio, as well as the previous owner's sophistication, or perhaps his lack of meddling, that most of these adjustments were already either spot on or not very far off. Once I had a working screwdriver, it took only a few minutes to go through the entire i.f. channel.

❖ Front End Alignment

The r.f. (front end) adjustments aren't too difficult as long as one works carefully and methodically. The test signal (a different frequency for each of the six bands – two for the 200-500 kHz band) is fed into the antenna and ground terminals of the receiver from the signal generator via a dummy antenna. The latter gadget is used whenever aligning sets intended for use with an outside wire antenna – especially high-performance communications receivers.

The dummy antenna is simply an electrical

Band No.	Freq. Range	Alignment Frequency	Osc.	Trimmers* Det.	R.F.	Ant.
1	200-500 kc.	(500 kc. 200 kc.)	6-1 10	3-5	3-3	2**
2	1.5-3.5 mc.	3.5 mc.	6-2	5-5	5-3	5-1
3	3.5-6.0 mc.	6.0 mc.	6-3	3-6	3-4	3-1
4	6.0-9.5 mc.	9.5 mc.	6-4	5-6	5-4	5-2
5	9.5-18.0 mc.	18.5 mc.	3-7	7-2	7-1	3-2
6	13.5-18.0 mc.	18.0 mc.	3-8	4-3	4-2	4-1

Fig. 2. Chart of alignment data from service manual showing front-end test frequencies for each band as well as designations for trimmer locations.

network that simulates the electrical characteristics of an actual antenna. I discussed the device in this column a few years ago during another restoration, and am repeating the schematic here as Figure 1.

With the signal generator and dummy antenna hooked up to the receiver and the a.c. vtvm connected as before, I went through all of the adjustments as outlined in the service manual. The table of Figure 2 shows the test frequencies for each band and the locations of each of the trimmers to be adjusted for that band. Figure 3 shows how the codes in the table are used to find various adjustment locations.

For each band, one first sets the signal generator to the specified frequency – using as low a level as possible and with the receiver avc turned off – and checks to see that the signal is coming in at the proper place on the dial. If not, the oscillator trimmer is carefully adjusted until the signal peaks at the proper dial calibration. After that, the detector, r.f., and antenna trimmers are peaked.

Each of the coded openings in Figure 3 gives access to a screwdriver-adjusted trimmer. Metal screwdrivers are ok here – which is just

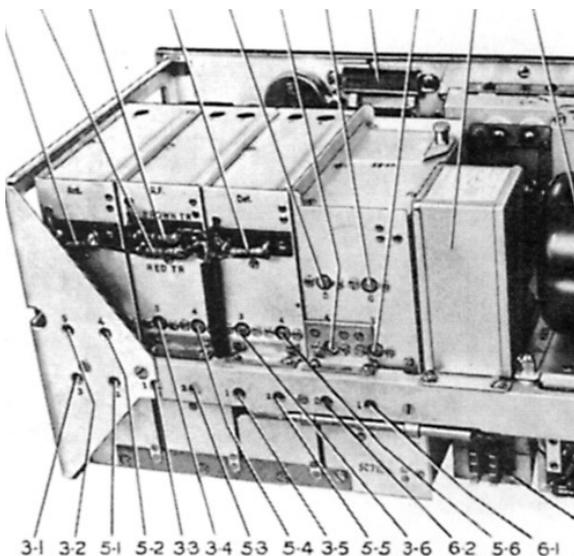


Fig. 3. Section from manual illustration showing how trimmer locations are identified by designations from alignment data chart.

as well because some of the adjustments were hard to break loose after decades of disuse.

Though almost all of the adjustments were reasonably close to their proper positions, they were far enough off that I was able to make significant improvements in receiver sensitivity. During several adjustments, I had to reduce the signal generator gain several times to avoid pinning the vtvm.

Only one set of adjustments was really far off – the one for band 2 (1.5 - 3.5 MHz). In fact, I had to move the oscillator trimmer so far that I wondered if perhaps I had the oscillator frequency on the wrong side of the received frequency. On bands 1 through 4 (see Figure 3), the oscillator runs at 915 kHz above the received frequency; on bands 5 and 6, it runs at 915 kHz below the received frequency.

Either arrangement results in a 915 kHz signal that can be amplified by the i.f. channel. But (without going into the reasons why), the tuning of this receiver is optimized for the configurations as stated. I was concerned enough to check on the possibility of an incorrect oscillator setting, but I don't happen to own a frequency counter.

It took me a moment, but I finally thought of using my navy LM frequency meter (the army version of this instrument is known as the BC-221). Using an internal crystal for reference, the LM can generate fundamental and harmonic frequencies of high accuracy in the range of 125 kHz-20,000 kHz. It can also measure frequencies anywhere in that range by zero-beating them against the accurate signal being produced within the instrument. Perhaps we'll cover the LM, or BC-221, in a future series of articles.

In measuring mode, The LM is really intended to work with emissions generated by a radio transmitter. I had no idea if it would be sensitive enough to pick up the tiny signal from the BC-348's oscillator. If the oscillator were running, correctly, at 915 kHz above the received signal on band 2, it would be at 4415 kHz with the dial set at 3.5. If running the same amount

below the received signal, it would be at 2585 kHz with the receiver dial set at the same position.

I wrapped several turns of stiff insulated wire around the 6C5 oscillator tube and connected the free end to the input binding post of the LM (which is also the output binding post when it is used as a signal generator). Setting the '348's tuning dial to 3.5 MHz, I set the LM's vernier for 4415 kHz and rotated it in both directions from that point to see if I could pick up a heterodyne.

Sure enough, I heard a tiny but definite zero beat in the LM's headphones after just a few rotations away from the set position. It corresponded to a measured frequency of 4443 kHz. The LM has an accuracy of .01 percent at this frequency, so I felt that I was close enough to feel reassured. Of course, to check that I was really picking up the receiver oscillator, I

moved the receiver's tuning dial back and forth to make sure that the zero beat in the LM also moved.

❖ More Problems!

With the alignment completed, I could now hear a reasonable number of DX signals on most bands, but still nothing on the 200-500 kHz band. Doing a little testing on the receiver's front end,

it was quickly apparent that the first two r.f. stages – though working – were not working properly. Signals were as strong, or stronger, with the antenna connected directly to the grid of the first detector than when connected to the set's antenna terminal.

I had earlier checked the operating voltages on the pins of these r.f. tubes and found them to be ok; now I checked them again with the same result. I also rechecked the tubes themselves and found them to be still healthy. In addition to typical voltages, the service manual provides data on the resistance to ground expected at each of the tube pins – and here I found some anomalous results that might hold the key to the problem.

And so, though I had hoped to button up the BC-348 at the end of this work session, it has come up with yet another hurdle to be overcome. I hope you readers aren't becoming impatient with my devoting so many columns to the problems of one receiver. Personally, I've been quite fascinated by the challenges presented by this long-neglected shed-stored radio.

So often, when working with a vintage set that was treated with respect during its useful life and then stored under reasonable environmental conditions, a careful recapping and alignment touch-up is all that is needed to re-establish satisfactory operation. However, such restorations don't make the most interesting reading – and a difficult case like this makes an excellent laboratory for illustrating troubleshooting techniques that might be used to restore better equipment!

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Finishing Touches for the BC-348

❖ From the Readers

Along with the previous Trans-Oceanic story and our earlier work on the military command receivers, this BC-348 project certainly ranks as one of the most popular in the history of "Radio Restorations." I appreciate hearing from all of the readers who e-mail me about their own BC-348 adventures – and here, to kick off the column, is the latest batch.

Bill Oelker, KN8DMK, has carried out a restoration that puts mine to shame. His BC-348P came to him unmodified and looking mint – except for a small amount of rodent damage in the wiring. It even had the dynamotor (in this case a 14-volt one) still in place. However, Bill began, as I did, by replacing all of the many molded paper capacitors under the chassis. This is a step without which no BC-348 restoration would be complete or reliable. He also replaced four carbon resistors that were burned or otherwise out of spec.

Bill's restoration experience now diverged radically from mine. As he began realigning the r.f. stages, he found that some of the trimmer capacitors were not adjusting properly. This necessitated the removal of the r.f. and oscillator modules for inspection.

To do this, one must first remove a shield from the bottom of the tuning capacitor, giving access to the short heavy leads from the modules to the capacitor. These can now be desoldered and removed. Additional wiring to various points on the module cases must also be removed after being tagged for later identification.

There is a flat shaft, rotated by the band change control, that runs through a bandswitch wafer in each module. Once its holding screw is released, the shaft can be withdrawn from the end of the receiver. This frees the modules for removal after the various screws securing them to the chassis are released.

With the modules removed from the receiver, Bill found that the rotor assemblies in a number of the adjustment trimmers were loose and shorting against the stators. The problem was caused by hairline cracks in the hex adjustment nuts. Because of those, the nuts lost compression on the rotor shafts – which then came loose, allowing the rotors to flop around.

I think that most people – including your columnist – would have now shelved the receiver, perhaps to be used as a parts donor or parts recipient after another set had been found. Not Bill, though. He found a way to reestablish compression and hold it by drilling holes in the nuts so that wire pins could be installed.

A heroic fix indeed! I had been tempted to

remove the modules myself, just to apply contact cleaner to the bandswitch wafers and check for bad fixed capacitors. I stopped short of doing that, however – particularly since my parts list showed that all of the module capacitors were mica rather than paper. So I could reasonably cross my fingers and hope that they were all good.

Jerry, NR5A, was inspired to acquire a BC-348-Q after reading some of the earlier installments of this column. After figuring out how to reconnect some of the displaced leads from the previous owner's power supply, he found that his set works like a champ! He does intend to recap the radio and has ordered all of the parts. But for now, he's having too much fun listening to it.

Jerry finds the set to be remarkably stable, and he is easily able to adjust the bfo for reception of ham ssb signals. He plans to team it up with a Knight T-50 transmitter now being restored to recreate an early Novice station.

He sent a picture of his BC-348 and I'm including a section of it here to show a solution to a problem I haven't coped with yet. Note the light-colored (red if you are looking at this in color) cylinder under the cabinet. It might be an upside-down bottle cap.

One of these is installed under the rack mount fitting at each corner. They keep the fittings from scratching furniture and also raise the cabinet up enough to clear a downward protruding front lip. Of course this strategy wouldn't be necessary if one had an original rack mount for the receiver – which would also contain a handy socket for the receiver's interface plug. But I don't know anybody who has one of those!

Thanks to **Michael D. Allen, W6EAV**, who sent some useful hints about a.c. power supplies, as well as about the transistorized "dynamotor replacement" published earlier in this column. Michael also included complete design information – unfortunately too voluminous to be included in this column – for a power supply to replace burned-out vibrator power packs in vintage auto radios. Though he didn't specifically offer, I'm taking it upon myself to include his e-mail address (it's mmddaa@hotmail.com) because the design

looks as if it could be very helpful to other restorers.

R.L."Pete" Stull, WB7AMP, happened to pick up a copy of *MT* at a Barnes and Noble bookstore and noticed the BC-348 coverage in this column. He has several of the receivers and was interested in obtaining copies of any previous article covering the BC-348 power supply. This is a good place to mention that, though I'd like to help, I'm not set up to send copies of my articles to readers. In such situations I'd have to suggest contacting *Monitoring Times** or visiting a library that carries our publication.

What I have recently done is to create a content index of all previous BC-348 articles. I e-mailed Pete a Word doc of this index, but you can now find it on the web page associated with this column (www.monitoringtimes.com/html/radio_restorations.html) along with indexes for all past "Radio Restorations" projects.

Clayton Hallmark, W5ZWM, writes that these columns have stirred up fond memories of a BC-348-R he owned early in his ham career. Now he's tempted to get into some restoration work himself. **Harold Richardson** has no less than three BC-348s he'd like to restore and has asked for information for my past columns on the subject. I sent him an index as well.

Bobby, K4VE, an enthusiastic reader who has corresponded with me before, is looking for suggestions on where to find a capacitor tester such as the one I've been using in these columns. He has a modern digital checker, but it lacks that all-important leakage test function. However, virtually all checkers that were made for tube radio servicing are set up to test leakage.

These are still plentiful at hamfests and antique radio meets, and I recommend one of the units made for the radio service trade by capacitor manufacturers such as Sprague or Cornell Dubilier. These usually sell in the same price range as the Heath or Eico kits and are much better units. I'll keep my eyes open for an extra unit that I can restore on these pages.

❖ A Remarkable Video

Recently someone called my attention to an amazing, almost hypnotic, 17-minute video posted on line by a French ham showing how he constructs replica vintage vacuum tubes. The deftness with which he forms the glass and metal parts and the efficiency with which he solders, spot welds, and exhausts air – with much of the equipment apparently home constructed – is remarkable to behold.



Jerry, NR5A used plastic shields (upside down bottle caps?) under the rack mount fittings of his BC-348 to protect furniture.

The complete construction sequence is shown, followed up by the running of characteristic curves on the finished product and a demonstration of the tubes as used in an operating vintage style transmitter and receiver. Take a look! You'll find it at

http://blog.makezine.com/archive/2008/01/make_your_own_vacuum_tube.html (NOTE: odd spelling of "vacuum" is correct for this URL)

❖ BC-348 R.F. Stage Problem

In the last issue, we corrected the cause of the erratic and distorted audio with which our radio was plagued. A new audio coupling capacitor was installed to replace the leaky one, and a missing tone control capacitor was also replaced. Now the audio sounded okay, but I noticed that the B plus voltage was about 80 volts too high.

Apparently the current drain of the audio stages had been abnormally high because of the bad coupling cap. Fixing it reduced the current – thereby reducing the voltage drop across the power supply series resistor and raising the B plus. Increasing the value of the series resistor corrected the problem.



The BC-348's removable r.f. modules. From left: first r.f., second r.f., converter, oscillator.

With the audio cleared up, we could proceed with the i.f. and r.f. alignment of the receiver. This certainly enhanced the sensitivity, but there was still a problem. Though the two r.f. stages were passing signals and had even seemed to peak satisfactorily during alignment, they were not amplifying. In fact, when they were bypassed by connecting the antenna directly to the converter grid, the signals actually got louder.

This month's work session began with a check of the operating voltages at the first and second r.f. tube pins. These were reasonably close to the typical values given in the maintenance manual. However, a resistance check turned up a too-high reading in the plate circuit of the first r.f. tube. Luckily, the plate resistor was not inside the first r.f. module but mounted externally on the back.

What was supposed to be a 4700-ohm resistor now measured almost 6500 ohms. After changing it, I thought it would be a good idea to recheck the r.f. alignment and it is well that I did. I was now able to get significantly higher peaks than the ones I had obtained with the bad resistor.

❖ The Mysterious Voltage Regulator

With this particular radio, correcting one

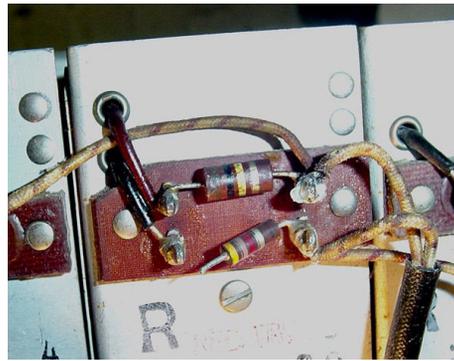
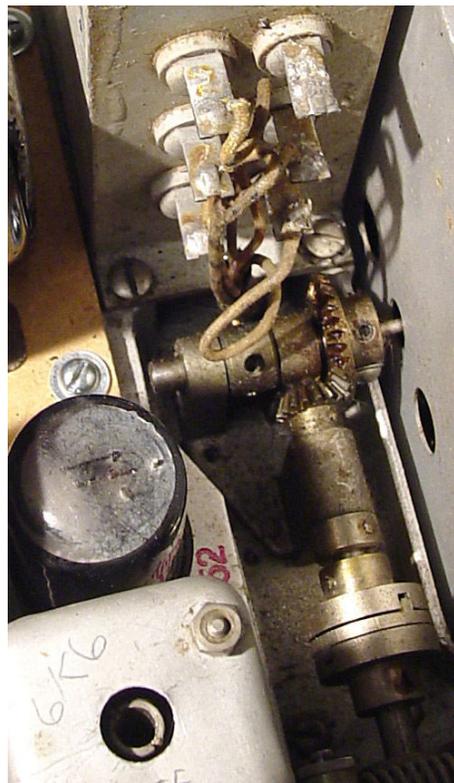


Plate and grid resistor are mounted on back panel of r.f. modules. The 4700-ohm first r.f. plate resistor (shown disconnected) measured almost 6500 ohms, so was replaced.

problem often seems to lead to the uncovering of another one. And this work session was no exception. The operation of the neon oscillator voltage regulator lamp had always been erratic. It always lit when the power supply was first turned on, but usually went out after the tubes warmed up and began drawing current. But after the last work session, the lamp surprised me by remaining lit (as it was supposed to) after warmup.

I was happy to see that, and thought it might have been due to the power supply voltage adjustment I had made – even though that had lowered the plate voltage. But now I believe it was caused by the oscillator adjustment I had just made. My clue was that the lamp had reverted to its old behavior after the latest round of r.f. adjustments, which included an oscillator touch-up on some bands.

The continued ignition of the lamp is de-



Actuating shaft from geared band change control (right center) can be seen entering hole in wall of oscillator module (see text).

pendent on the oscillator plate current draw, and I remembered that at one time I had suspected some type of irregular oscillator operation as I was tuning the set during tests. As a possible remedy, I had purchased a replacement "new-old-stock" 6C5 oscillator tube during one of my last parts orders, but had not yet installed it.

Now I did install it, and the lamp promptly returned to its normal behavior, remaining on after warmup. This turn of events might seem rather odd to some readers, but temperamental oscillator operation – even with tubes that test perfect – is far from an unknown occurrence. I'll keep an eye on the lamp as I continue to use the set to see if my theory is proven true.

I'd love to tell you, now, that I had carried the set out to my garden shed shack, hooked it up to a good antenna, and found that the performance was gratifying. Maybe next time! Right now the temperature is one (1) degree with the windchill factor about 5 below. And even though I can heat the shack, I don't feel like making the frigid trip!

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